the OIL AND GAS JOURNAL
PUBLISHED WEEKLY MAY 8, 1961

Gross income per well needs a boost
p. 146

JOURNAL SURVEY SHOWS:

Natural-gas-storage capacity still climbing

. . . but at a slower rate p.83

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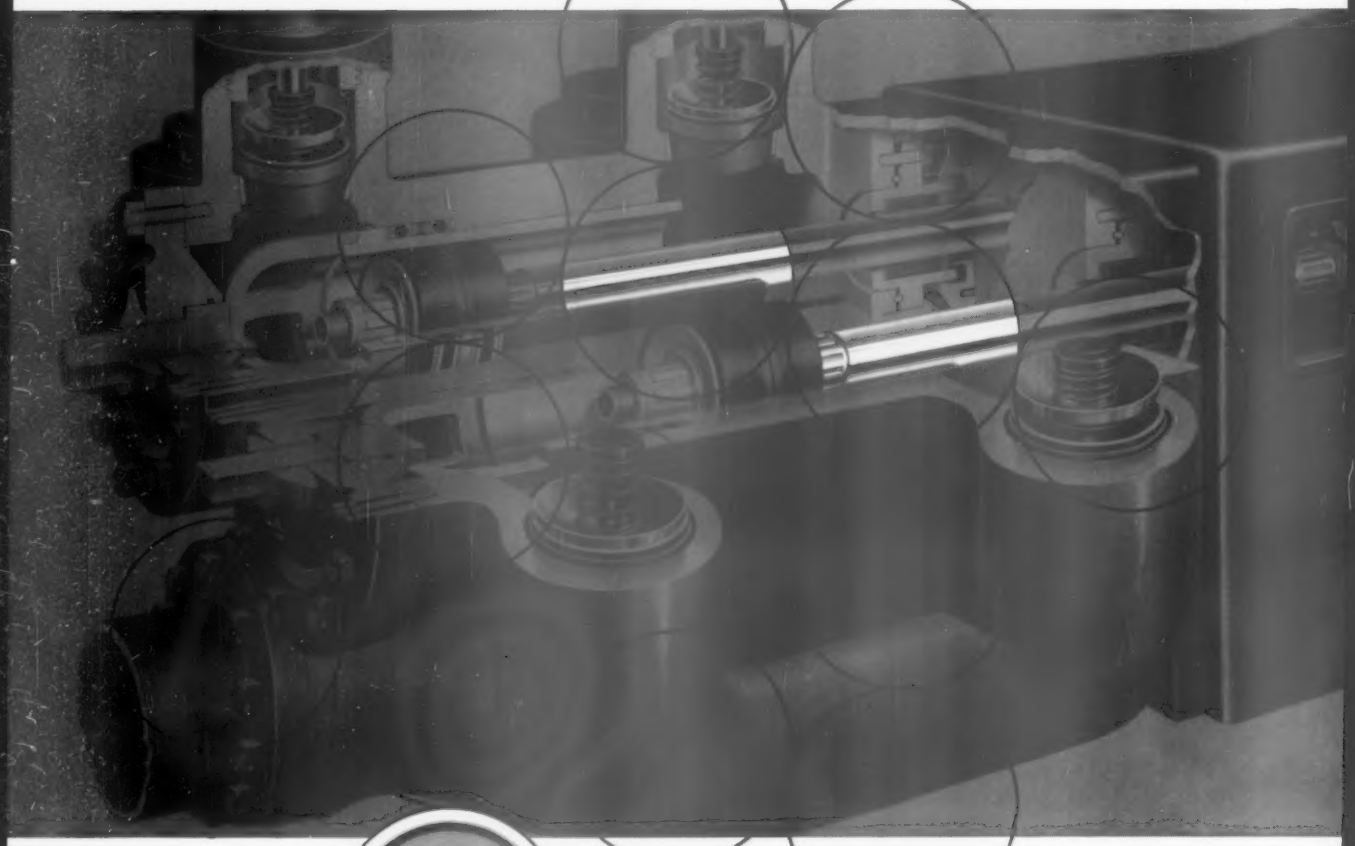
Optimizing power costs on crude-oil pipelines ▸ 102

Mission rods are here to stay



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Ordinary rods must fight corrosion fatigue as well as the fatigue from tensile and compressive stresses. But, the tough, hard-chrome plating you see in the photograph protects Mission Super-Chrome® rods against corrosion fatigue. That's one more reason Mission rods last longer. Beneath the coat of heavy chrome you can see the deep, file-hard case. Inside is the tough, high strength core. Its unusually high ductility will resist the fatigue induced by literally millions of tension and compression cycles, while the chrome plating resists the corrosion fatigue which could be induced by millions of gallons of drilling fluid. Mission Super-Chrome rods are sure to stay in your pump longer than any others. Specify Mission parts all the way and save all the way.

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The Oil and Gas Journal is published weekly by The Petroleum Publishing Co., 211 S. Cheyenne, Tulsa 3, Okla. Second-Class postage paid at Tulsa, Okla. Copyright 1961 by The Petroleum Publishing Co. United States and foreign rates to the petroleum industry, 1 year $6, 2 years $9, 3 years $12.

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the OIL AND GAS JOURNAL Newsletter

May 8, 1961
Tulsa, Okla.

Economic currents are tricky for the oil industry these days.

First-quarter operations underscore this situation:

Integrated companies showed excellent profit gains in the quarter with some setting records for earnings. The bright showing leads executives to predict a rousing year (p. 57)*.

But total domestic demand for the same period lagged expectations by 235,000 bbl. daily with unseasonable weather blamed. This first-quarter performance plus a slower than expected revival in general economy have prompted IPAA to revise its demand forecast downward.

The new supply-demand outlook: Domestic demand 9,818,000 bbl. daily, export 175,000 bbl. daily, for total demand of 9,993,000. This will be supplied from domestic crude production of 7,104,000 bbl. daily, natural-gas liquids output of 997,000, imports of 1,860,000, and drawdown from stocks of 32,000 (p. 72).

▼ ▼ ▼

Other economic trends you'll find interesting:

Producer income per well has been down for past 3 years. The average well in U. S. last year produced $13,730 worth of oil or gas. The postwar record was $14,900 per well in 1957 (p. 146).

Crude prices over last 12 years have not increased enough to cover inflation. Expressed in 1960-value dollars, crude brought $3.23 per barrel in 1948 and $2.92 last year.

Drilling costs have leveled off. IPAA cost-study committee says per-well costs rose only 2% and per-foot costs 0.3% last year. The average jump in previous 10 years was 7.5% in per-well and 5.1% in per-foot costs. Principal factors: Price of casing, bits, and mud stayed the same. Labor went up only 1.1%. Special services rose only 0.7%. Equipment rose only 0.1% last year. The contractor's cost per well was the lowest in 10 years.

Rotary-rig activity is up again—to 1,746 now, a gain of 55 rigs in a week, for highest point of year.

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Journal editors over the country write these notes:

Trends in drilling as year wears on, says a West Coast veep for

*Refers to article in this issue giving more details. When no page is given, the item is a Newsletter exclusive.

exploration, are running against any big jump in well completions.

His reasoning: Wider spacing is more common and will cut into number of completions. There also are no big oil finds being made this year so far to justify stepped up drilling.

Offshore drilling contractors are in better shape—in fact they're making some money.

All deep-water rigs (capable of working below 40 ft.) have a backlog of work. One worry: All the offshore rigs are several years old now; the new has worn off; and maintenance costs are climbing.

Offshore drillers hope the Government and Louisiana soon will arrange for a Zone 2 lease sale. Acreage in this zone, between 3 and 10 miles out, is some of the most promising on the continent. Also a sale would stimulate demand for shallow-to-medium-depth drilling barges. Last year's zone sale of deeper-water leases caused the big jump in demand for deep-water rigs.

One top pipeliner wagers automatic welding developments—the hottest news in pipelining now—will not affect advantages of double jointing in the yard for speeding up a spread. Some of his friends think double jointing will now fade out, however.

A midwestern refiner is intensively studying bacteria in petroleum products, especially jet fuels.

Using cultures, researchers have readily produced bacteria which could easily clog filters and pumps on jet planes' fuel systems. They say filters taken from some planes are badly clogged.

An additive already used in motor fuels has shown remarkable results in eliminating the trouble. Tests are now being made to determine effects of the additive on turbine blades.

One veteran refinery researcher thinks refiners are kidding themselves if they think they can produce a low-cost hydrogen. He says cost would have to run at least three times that of the charge stock used whether it be gas, oil, coke or coal.

Reverse twist to automation comes from the credit segment of marketing. Collections have fallen off sharply after inauguration of punched card billings. This is true even of good customers including industrial and commercial accounts.

One marketing executive says the cause is not entirely economic conditions but the "coldness" of the automated billing. The cards need a more personal flavor.

▼ ▼ ▼

Talk of more products lines building was heard among the pipeliners attending the St. Louis API conference. Little new construction is expected on crude lines.

Reasons for interest in products lines: Population shifts into urban centers, growth of LPG, and possible use for transporting other products by pipeline.

A fortune awaits the inventor of a device that can be run through a pipeline to detect external corrosion.

One major pipeline could use the tool now—it faces the prospect of uncovering several hundred miles of line. Engineers are certain not more than 5% of the line will have to be replaced but the entire line must be uncovered at great cost to find the defective 5%.

Use of computers in pipeline operations keeps on growing.

One company is processing data on leaks and setting of anodes. The information gives it the proper location, size, and expected life of its cathodic protection devices.

Another pipeline is switching from cobalt to cecium as a radioactive source for detecting interfaces between product batches. Detection devices are highly sensitive to it.

Race to perfect automatic field welding of pipelines has attracted the U. S. Engineers. While others use shielded-arc welding, the engineers are using induction heating-pressure process.

Under this technique, the pipe ends are expanded, milled to assure full face-to-face contact, pressed together at 2,500-3,000 psi. and heated with an induction coil to 2,600° F. Actual welding takes about 30 seconds, the full cycle about 90 seconds.

A pipeline from Tampico region of Mexico across the U. S. border near Brownsville is being explored by a U. S.-Mexican group. Idea is to form a private Mexican corporation to build the line and then sell it to Pemex.

Mexican crude then could enter the U. S. without restriction under the overland exemption, avoiding present tanker-truck gimmick.

▼ ▼ ▼

The Washington beat:

Latest development in residual fuel-oil import situation:

...OCDM Director Frank Ellis will meet with New England senators this week. Announcement whether OCDM will hold hearings is likely to follow.

...Petroleum Industry Research Foundation is joining the group urging the OCDM to hold hearings to determine if controls are needed for national security.

Senate Commerce Committee may act soon on appointments of Joseph Swidler and Howard Morgan to FPC. Committee was trying to wind up dragged-out hearings late last week and had tentatively set an executive session for early this week.

Note that most jobbers—probably more than 80%—are being exempt from paying overtime in minimum wage legislation passed by Congress late last week. Virtually all service stations are exempt from both minimum wage and overtime provisions.

Russian gas delegation, due some time this month to tour the U. S. industry, still has not been heard from. The AGA and State Department sponsors were waiting word on Russians' definite plans. An American delegation will go to Russia in July. The countries swapped oil tours last year.

Market Memo

May 8, 1961

Prices are taking an off-season beating.

Gasoline in the sprawling Mid-Continent region fell from three-fourths to a full cent before the motoring season begins and at a time when refiners appeared getting supply nearer a balance.

Distillates also fell a half-cent in the Mid-Continent following the same cut a week earlier on the Gulf Coast. Same result was accomplished on the East Coast by the start of summer-fill discounts.

The Mid-Continent changes put regular gasoline there in a spot-price range of 11.5 to 12 cents per gallon, No. 1 in a 9.5-10-cent range and No. 2 in a 8.5-9-cent range.

Gasoline price weaknesses and discounting had been reported for several weeks around such areas as Twin Cities, Chicago, Kansas City, and Des Moines. When they spread out from these areas, nearly all suppliers adjusted postings to protect their markets. Gasoline on the Gulf and East coasts was reported as continuing rather quiet.

The distillate changes are purely seasonal—sales won't be very good even at the new prices. Mid-continent refiners adjusted to meet Gulf Coast pricing. On the East Coast Esso installed its summer allowances of 0.4 to 0.5 of a cent per gallon to resellers. Atlantic cut its prices uniformly a half cent on the East Coast and 0.4 of a cent along the Plantation Pipe Line.

Refiners seem intent on stabilizing the markets by keeping lid on refinery runs. They were off 27,000 bbl. daily last week, averaging 7,738,000. Since March 3, runs have dropped 1,736,000 bbl. daily.

Gasoline stocks dropped 2,908,000 bbl., making a 5-weeks' drop of 7,350,000 bbl. They're still a little high at 291,317,000 bbl. Distillate stocks also were off 600,000 bbl. to 84,008,000 bbl., which puts them in fairly good shape for the season.

Marketing notes: Tipoff whether regular gasoline will resume its steady octane rise should come this month. It has been stalled at 92.6-research since November but is expected to start up with the big promotional push of the motoring season. Skelly and Sinclair already have started plugging regular hard in their advertisements ...Sun has launched a big test of its nine-grades from a single pump in the Charlotte, N. C., area...Residual fuel markets in Minnesota and Wisconsin industrial plants are being hurt by inroads of natural gas from the Southwest and Canada. Refiners in the area may have to install cokers to cut back on their residual output...One part of new Canadian oil policy not yet publicly announced is planned movement of prairie crude by tanker down the St. Lawrence Seaway to Montreal refineries from pipeline terminals at Sarnia or Toronto. Movement will start in a year and will be gradually stepped up, removing pressure for immediate construction of huge crude pipeline to Montreal.

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OTIS PRODUCTION NEWS

Volume I, Number 5 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*

Type WA Otis Production Packer Solves Problem in Gas Injection Well

High Pressure, Strain, Tubing Vibration Cause Initial Completion Packer's Body to Part

MIDLAND — Type WA Otis Production Packers have proved to be the solution to a serious problem encountered by a West Texas operator on a secondary recovery project. The problem was to find a packer that would stand the stress and vibration of the tubing in a number of high-pressure gas-injection wells.

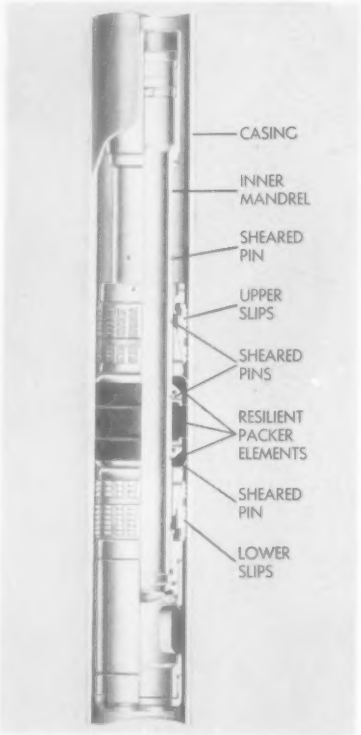
The wells involved were being used to inject gas into the Devonian at approximately 12,500 feet. Injection rate was 2½ M.C.F.D. at 7,500 P.S.I. Due to vibration created by this high rate of injection, the tubing was set in tension with a minimum of 25,000 pounds' strain. These conditions apparently proved too strenuous for the packers used in the initial completion for they disintegrated shortly after the wells were put into operation.

In analyzing this producer's problem, Otis packer specialists from the Odessa office felt confident the Type WA Otis Production Packer would stay in the hole in spite of the adverse working conditions because of the packer's "floating mandrel" design *(See diagram)*. This feature, unique among permanent-type retainer packers, is designed to prevent problems such as this which result when a packer's inner mandrel is permanently attached to the slips or packer body.

The Type WA Otis Production Packer is designed to meet today's requirements for an improved retainer packer for wire line setting. It is designed to be run into a well on an electric line and set by means of any pressure setting tool or on a hydraulic setting tool, which can be run on a sand line or electric wire line.

Unlike the packers originally used in these West Texas gas-injection wells, the inner mandrel of the Type WA Otis Packer is not pinned to either the upper or lower slips or the rubber element assembly once the packer has been set. The mandrel is free to travel up or down within the outer packer body approximately 8 inches before being confined by a shoulder at either end, and is sealed off and held in position by O-rings and pressure from the compressed rubber packer elements. In this way, vibration or movement of the tubing string when transmitted to the packer mandrel is partially absorbed by the rubber elements first, and not directly transmitted to the slips or the outer packer body.

As a result, Type WA Otis Production Packers have replaced the packers originally used in these injection wells and the operator reports all have proved satisfactory. Several additional wells are to be drilled for this project and Type WA Packers have been specified for each.



In the Type WA Otis Packer, all pins which serve to hold the slips and resilient packer elements in the running position are sheared when set, leaving the mandrel free to float.

The Type WA Otis Production Packer offers several other outstanding features in addition to its "floating mandrel" design. The packer is made of drillable materials and so designed as to minimize the time required to mill or burn over, should it become necessary to remove the packer from the well. The O.D. of the rubber elements is less than the O.D. of the end shoes to help guard against premature setting or damage to the rubber seal elements when running in. The Type WA Packer has a large bore to allow standard tubing to be used as tail pipe and to pass tubing-type perforating guns and other standard wire line tools. The back pressure valve at the bottom of the packer serves to eliminate contamination of the formation by mud or water when tubing is removed from the packer in the event BHP exceeds the hydrastatic head.

The solution to this West Texas operator's problem by an Otis Specialist was the direct result of the specialist's knowledge of his product and experience in the field. This type of help is typical of the service available from all Otis personnel. Their knowledge of production problems, and of the application, installation and capacity of their equipment permits them to make sound, on-the-spot recommendations. The next time you find it necessary to consult with someone regarding packers or well completion techniques, call the Otis office nearest you or write Otis, Dept. 4-P, P.O. Box 35206, Dallas 35, Texas. You'll find experienced Otis Well Completion Specialists ready to help you . . . anxious to serve you . . . and with the widest variety of field proven production equipment available today.

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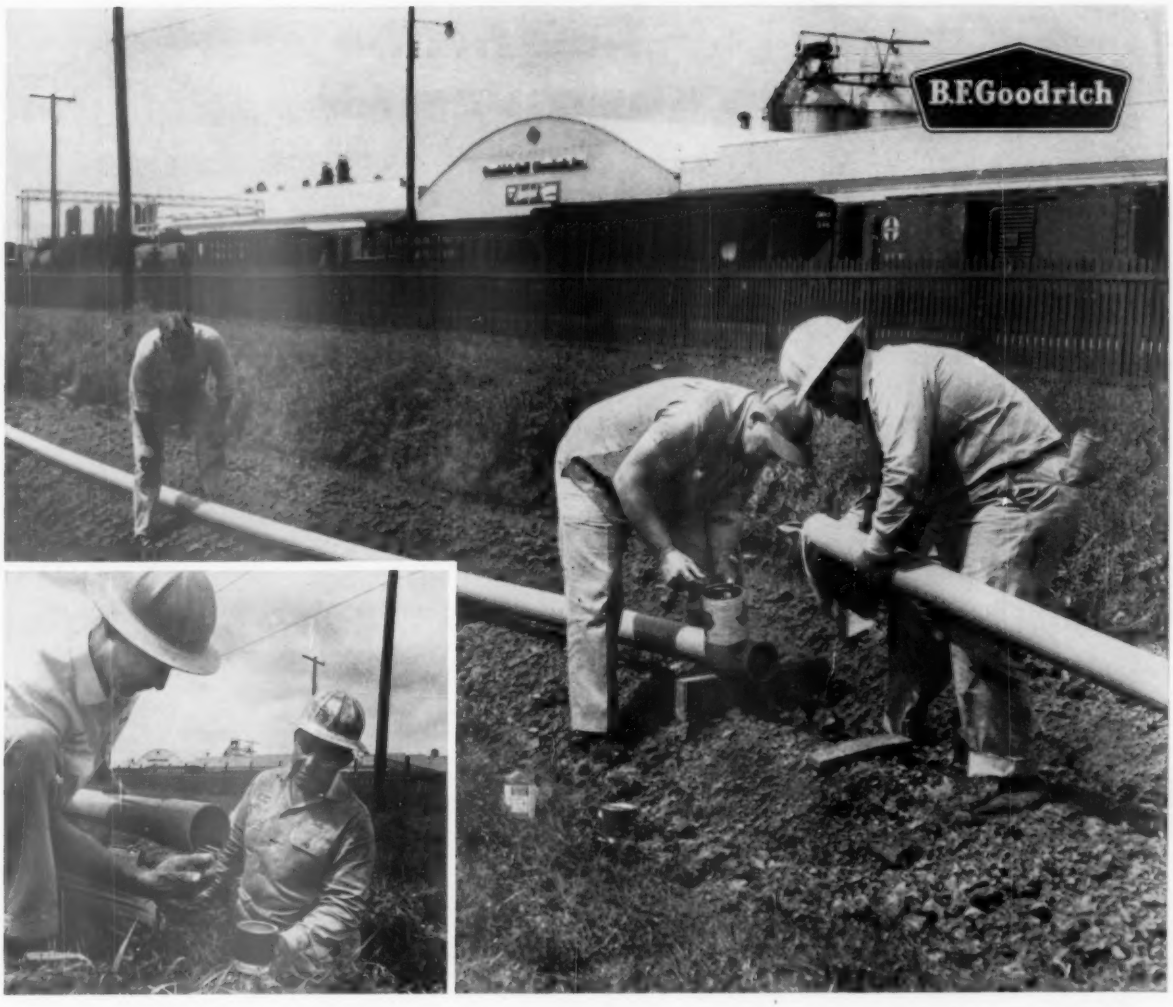

"Bringing in brine by pipe of Geon instead of tank trucks cuts our costs"

"When we used to have our saturated brine delivered daily by tank truck," says the superintendent of the Goodrich-Gulf Chemicals, Inc., plant at Port Neches, Texas, "the trucks created traffic problems and receiving equipment created peak pressures on plant and manpower—often at the wrong time. Now we're sure of a continuous supply of brine with minimum receiving problems."

Texas Brine Corporation likes the new arrangement, too. Since laying 12,000 feet of rigid vinyl pipe, their cost of delivery has been reduced to the cost of automatic pumping.

The pipe was easy to install, too. No wonder. Geon pipe is lightweight, can be joined by solvent welding—as is being done in the photo above. Geon in unaffected by most causes of corrosion—the brine can't harm it, and ground currents or inside deposits will never be a problem. It will continue to provide low-cost delivery for as long as it's needed.

Here's another example of the way that rigid Geon can solve piping problems. In other products, Geon provides whole new advantages, sometimes opens whole new markets. For information, write Dept. NL-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio.
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UOP No. S-7*	33⅓% solution of No. 7 for liquid injection into gasoline.
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FUEL OIL ADDITIVES	
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POLYFLO® 100 POLYFLO® 120 POLYFLO® 121 POLYFLO® 130	Fuel oil dispersants that inhibit degradation of color and formation of sediment in distillate oils . . . peptize sediment in processing equipment.

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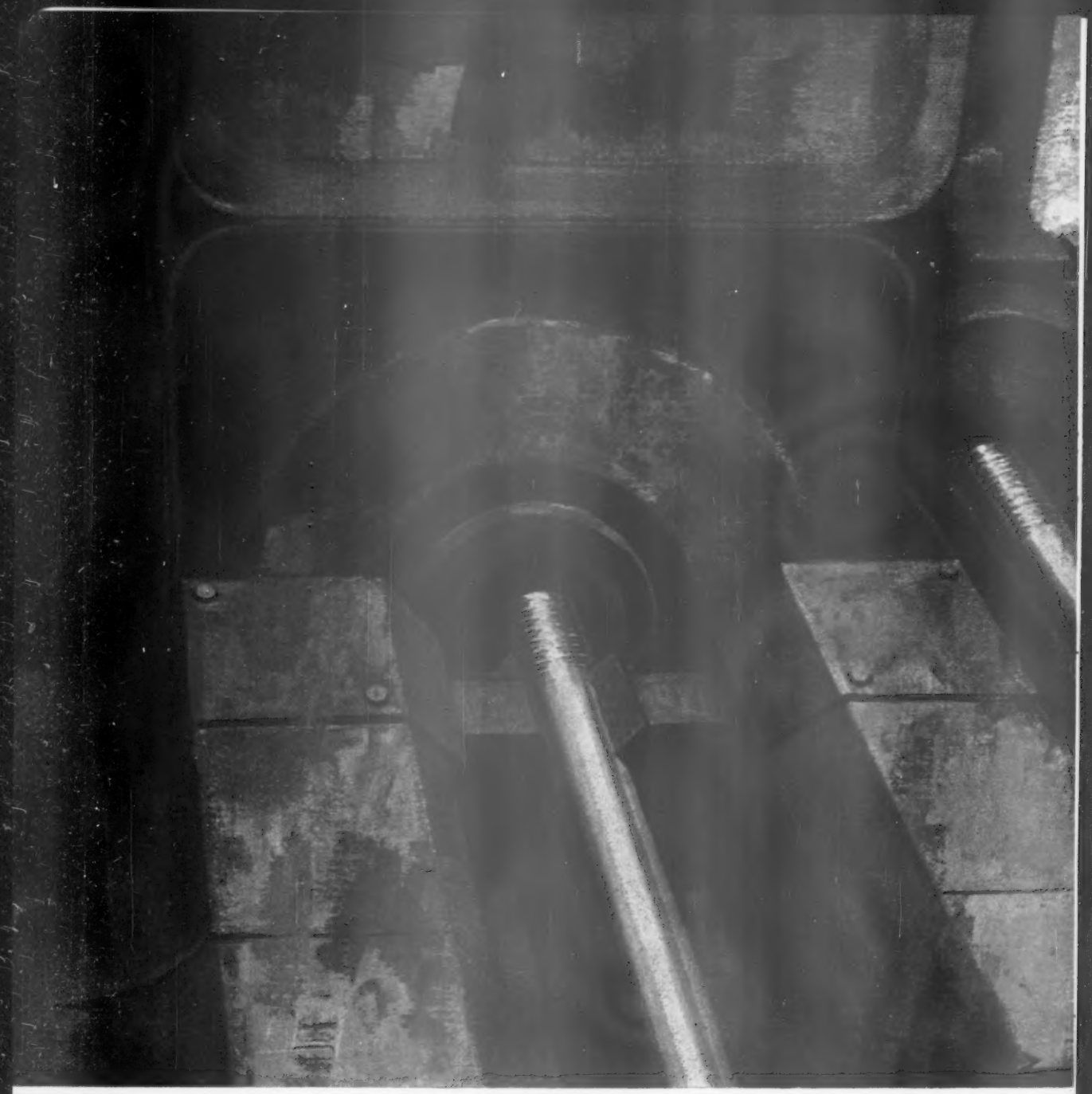

This machine bites clean.

The strength of any tubing joint depends a lot on how tight the joint makes up. The joint must have perfect threads. That's why National Tube has installed this special carbide threading machine to thread oil country tubing (2" to 4½" O.D.). The high-speed carbide tools cut threads that are the cleanest, strongest, most accurate ever produced. So, naturally they make a tighter connection.

National Tube uses two other carbide-tooled machines in this threading line—a profiler that

cleans the cutting surface, and a facer that end-faces, bevels and reams out the pipe. All three machines are linked into one continuous operation to produce perfect threads.

Carbide threading is only one of the many "extras" that National Tube uses to produce high quality seamless oil country tubing. Consider USS National Tubing for your next tubing installation.

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HOW HALLIBURTON HELPS YOU CUT CEMENTING COSTS

Halliburton cementing research continues to find cost reduction improvements in methods and tools for oil well cementing.

Many revolutionary improvements from Halliburton are today the standards of the industry. In addition to the more spectacular innovations, countless cost reducing developments and improvements are made through Halliburton's "perpetual engineering" program. Consider the tools shown on the opposite page . . . each has been designed for functional performance *and* to help cut cementing costs through time and equipment savings.

Add these savings to the experience of the Halliburton cementing crew, the unmatched performance of Halliburton cementing equipment, and the complete selection of Halliburton tools and materials. Time has proved this combination delivers the very *best* cementing service you can buy . . . the *only* kind Halliburton sells.

SAVE Casing Running Rig Time

HALLIBURTON SELF-FILL DIFFERENTIAL COLLAR makes it possible to automatically fill the casing string as it is being run. With this tool in the string, frequent stops to fill the pipe *manually* are avoided. Differential pressure acting across the valve in the Self-Fill Collar automatically opens and closes the valve to maintain a nearly balanced fluid head both inside and outside the casing, even in the deepest wells. The tool may be made inoperative at any time by dropping in a weighted plastic ball, or after cement is placed, by the top cementing plug.

SAVE Surface Equipment Wear When Running Casing

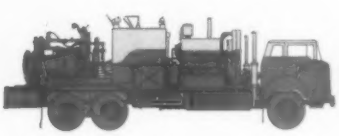
HALLIBURTON CASING FLOAT COLLARS AND FLOAT SHOES are designed to take the strain of running casing off surface equipment by transferring part of the casing load to the fluid in the well as the string is being run. This "fluid-tight" seal for floating is accomplished by Halliburton's *exclusive* Super Seal Back Pressure Valve. The Super Seal Valve automatically closes after cement placement making it possible to prevent the reverse flow of cement back into the casing. Exhaustive laboratory and field tests have proved that the conical band contact design of the Halliburton Super Seal Valve and Seat exceeds the sealing effectiveness of common ball and seat arrangements in this application. Another feature built into all Halliburton Floating and Guiding Equipment is the Plug Seat. This phenolic impact plastic insert provides added stamina at the point where the cementing plug lands with the tremendous force of the pumps behind it. This extra toughness helps prevent spalling common to other casing floating and guiding tools with cement-formed seats at this most important point. All internal parts of Halliburton Floating Equipment are easily drillable, including the built-in concrete guide nose on Float Shoes and Guide Shoes. The strong, durable, rounded guide directs the casing away from ledges and obstructions to minimize side-wall caving and aids it in safely passing hard shoulders and through crooked holes as it is being run.

SAVE Tack Welding Time and Expense

HALLIBURTON WELD-A eliminates the need for tack welding the bottom casing joints. Economical, Halliburton's thread compound has proved itself to actually exceed the holding strength of tack welding at this important point in the string.

For more information on these and other Halliburton tools and services, contact your Halliburton man. He is as near as your phone.

275 Service Centers
. . . just minutes away
from your well



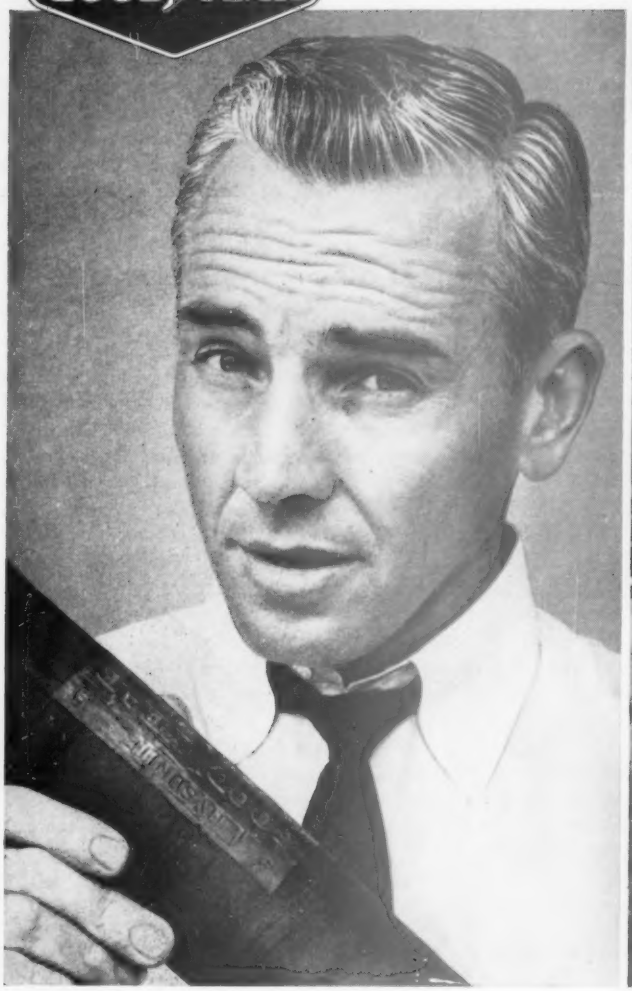
CEMENTING SERVICES

Halliburton

COMPANY • DUNCAN, OKLAHOMA

Why I always

GOODYEAR



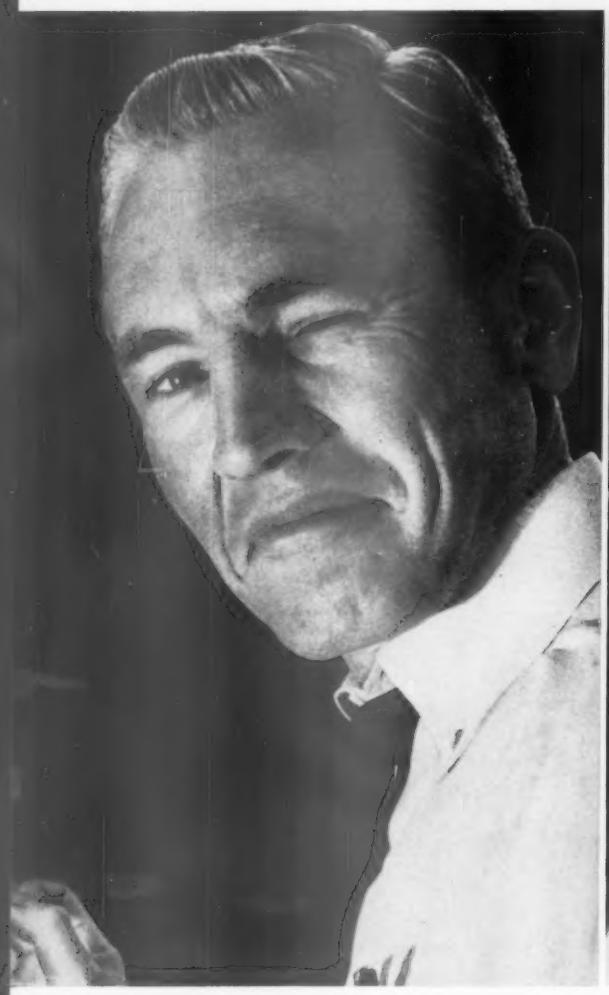
THEY MAKE EVERY HOSE I NEED
(No more time and money wasted looking for exactly the right kind of hose for a job *–Goodyear's got it!)*

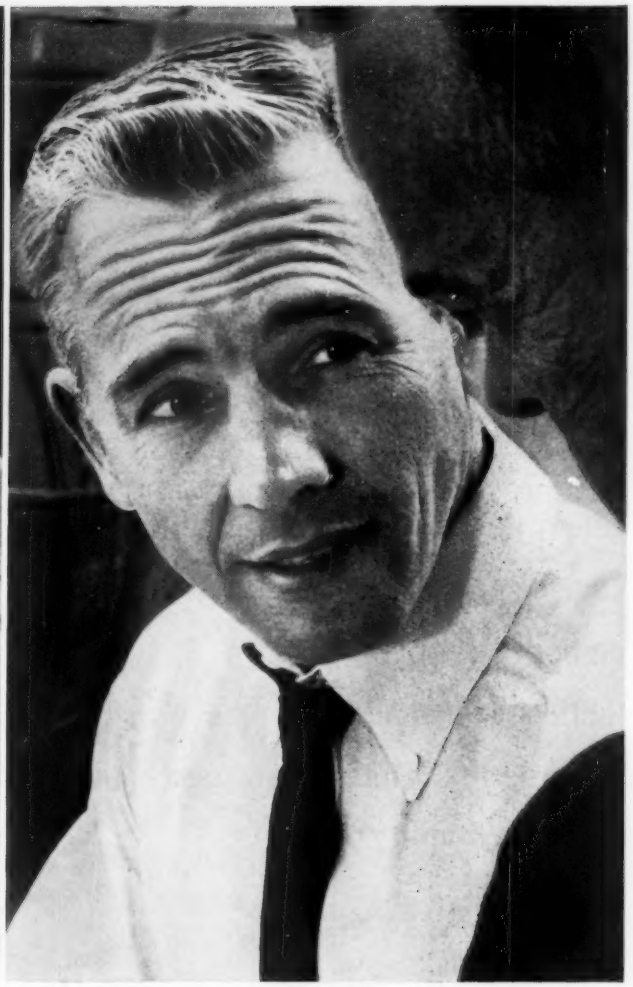
THEY'VE GOT FAST DELIVERIES I NEED
(No more out-of-stock delays! Via network of stocking distributors in all parts of the country–*Goodyear's got it!)*

For the right hose... at the right place... at your Goodyear Distributor... first in service

Lots of good things come from **GOOD**

buy hose from Goodyear





THEY HAVE TOP QUALITY I NEED
(No more settling for second-best. When it comes to quality, reliability and safety *—Goodyear's got it.)*

THEY OFFER TECHNICAL HELP I NEED
(No more guesswork. For expert help through the G.T.M. — Goodyear Technical Man—*Goodyear's got it.)*

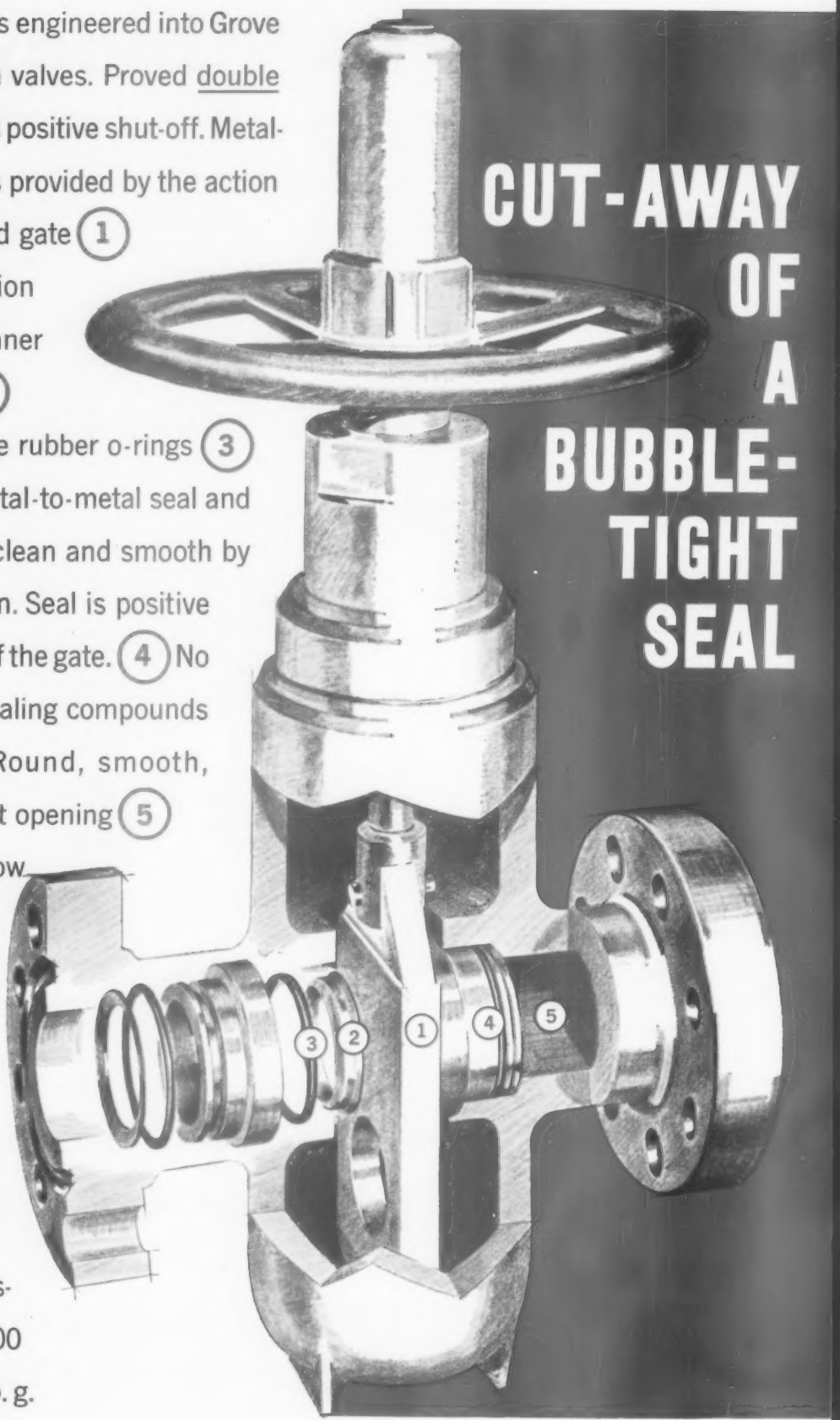
the right time... at the right price... call with all industrial rubber products

Or write Goodyear, Industrial Products Division, Akron 16, Ohio

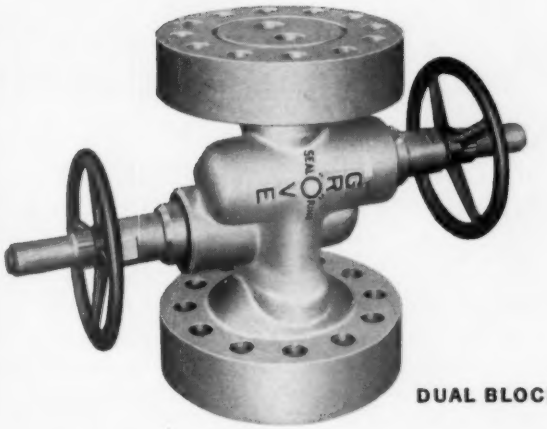
GOODYEAR INDUSTRIAL PRODUCTS

Dependability is engineered into Grove G-2 production valves. Proved double sealing assures positive shut-off. Metal-to-metal seal is provided by the action of parallel sided gate (1) against precision ground metal inner seat rings. (2) Protected nitrile rubber o-rings (3) back up the metal-to-metal seal and keep the gate clean and smooth by squeegee action. Seal is positive on both sides of the gate. (4) No lubricants or sealing compounds are needed. Round, smooth, through conduit opening (5) assures ideal flow characteristics and freedom to pass tools. Available also in dual block, balanced stem and recessed body types. Pressures from 1,000 to 10,000 # w. o. g.

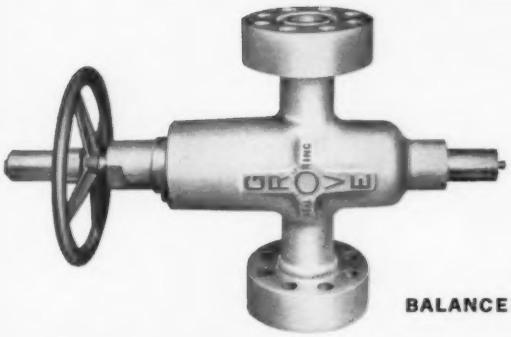
CUT-AWAY OF A BUBBLE-TIGHT SEAL



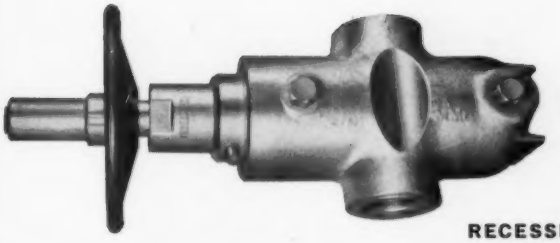
GROVE G-2 SEAL "O" RING GATE VALVES FOR PRODUCTION AND FLOW LINE SERVICE



DUAL BLOCK



BALANCED STEM



RECESSED BODY

GROVE PRODUCTION VALVES

GROVE VALVE AND REGULATOR COMPANY

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GROVE SEAL O RING

WAGNER® MOTORS AT WORK

power to move petroleum to market

Cool-running Wagner® 500 hp tube ventilated motor provides explosion-proof drive for pumping crude oil from storage to tankers at sea.

Logistically complex job, moving petroleum products to market. Demands skill and know-how. Demands plenty of power, too . . . power provided, in many instances, by Wagner Tube Ventilated Motors.

But powering the pumps that start petroleum products on their way to the corner service station is just one of many jobs performed by these stamina-packed motors. They are also used as drives for big fans, blowers, compressors . . . any heavy-duty application. Built in ratings through 500 horsepower, these totally-enclosed, fan-cooled motors are tube ventilated for cooler running, longer life. Type YP, standard TEFC, or Type ZP, explosion-proof, can be supplied with Underwriters' Label for hazardous locations.

When you need motors that can operate for long periods of time without maintenance . . . that keep right on producing the power you need even under the most critical conditions, choose from these Wagner® Big Job-Rated Motors. Check with your Wagner Sales Engineer; he'll show you how they'll solve your large motor problems.

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Wagner Electric Corporation

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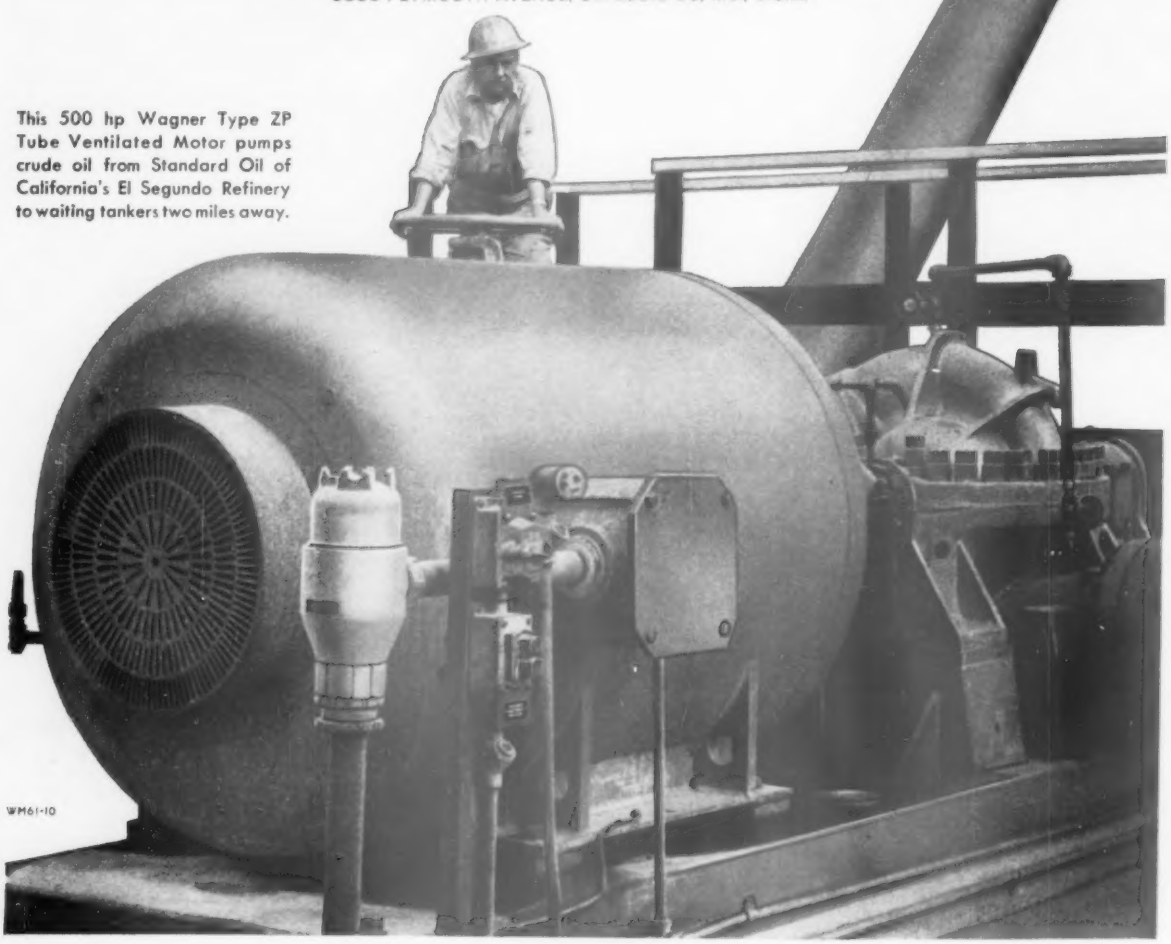
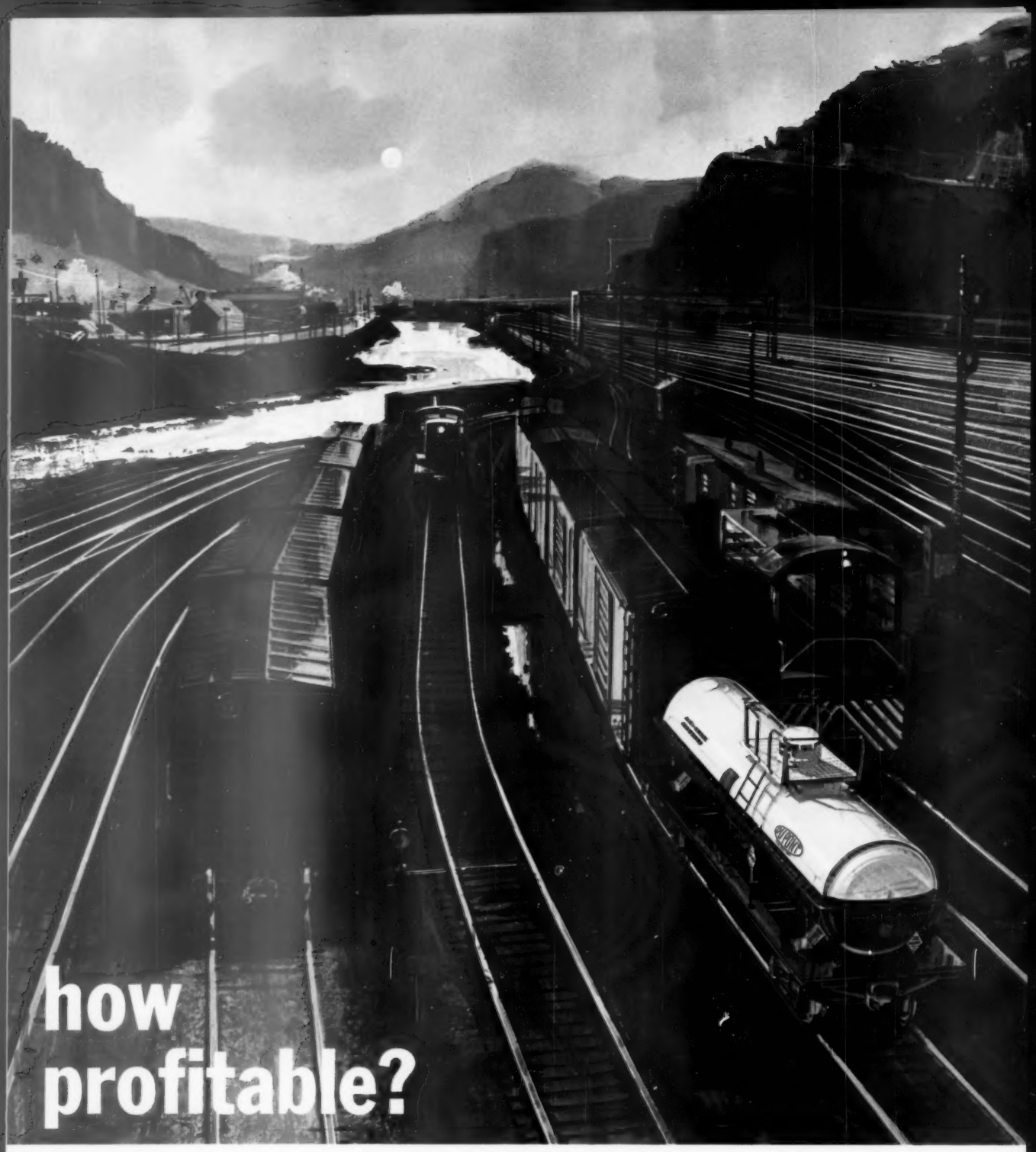


This 500 hp Wagner Type ZP Tube Ventilated Motor pumps crude oil from Standard Oil of California's El Segundo Refinery to waiting tankers two miles away.

WM61-10



With profits being squeezed, savings in refining costs, for example, are being actively pursued. That's why many oil companies are investigating TETRAMIX* antiknock compound — the new antiknock that, in many fuels, gives desired octane numbers at lower cost than is possible with TEL or TML. Helping you get such results is another practical advantage of doing business with DuPont.

E. I. duPont de Nemours & Co. (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.

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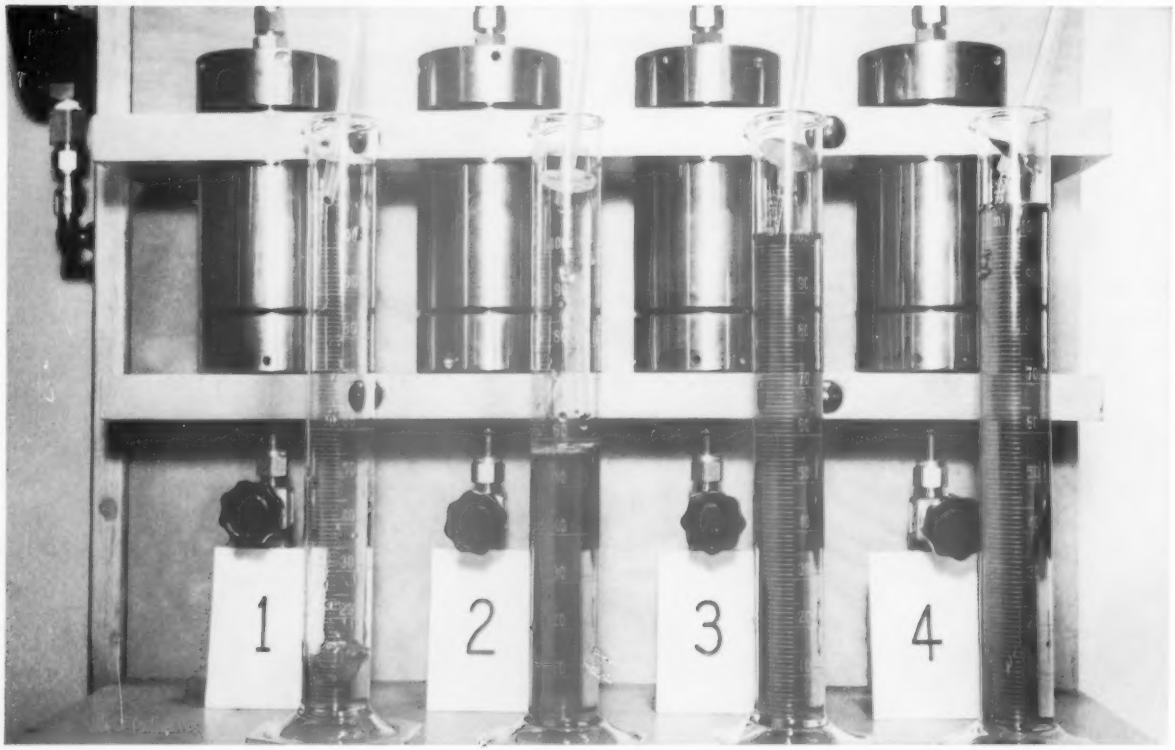
Better Things for Better Living ... through Chemistry

fracture conductivity tests help you make more profit



This Dowell-designed Fracture Conductivity Tester permits direct comparison of four different propping agents in a given formation. The rate of fluid flow indicates fracture conductivity. Note that the flow has only partly filled graduate 1 while the flow has passed the 100 ml mark in graduates 3 and 4.

This is a Fracture Conductivity Tester – one of several types being used by Dowell. Over 1000 fracture conductivity tests have been made by Dowell to help design more effective fracturing treatments in a wide variety of formations.

If you have noticed that recent fracturing treatments have given greater production increases per dollar than usual, you are probably reaping rewards from these 1000 tests.

In using the tester shown, duplicate plugs are cut from a core taken from the well to be treated. These test plugs are split to simulate fractures, assembled in flexible sleeves and placed inside the cylinders shown.

Various propping agents are introduced into the "fractures" in the desired concentrations – either by hand or carried in stimulation fluid.

Overburden pressure is simulated by hydraulic pressure applied to the outside of the test plugs.

Treating fluids – with or without propping agents – are injected and left in the samples under pressure for 12 hours or more.

Conductivity of the "fracture" in each cylinder is then measured using either reservoir fluid or a special test fluid such as kerosene.

The results of these tests, plus other pertinent well data, are then interpreted through the Frac Guide* – Dowell's engineered plan for designing optimum fracturing treatments.

Ask your Dowell representative for a free copy of the new "Technical Report on Fracture Conductivity." This report deals with the important factors affecting the flow of fluids through fractures, such as size, type and amount of propping agent, formation hardness and overburden pressure.

Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma. *DOWELL SERVICE MARK

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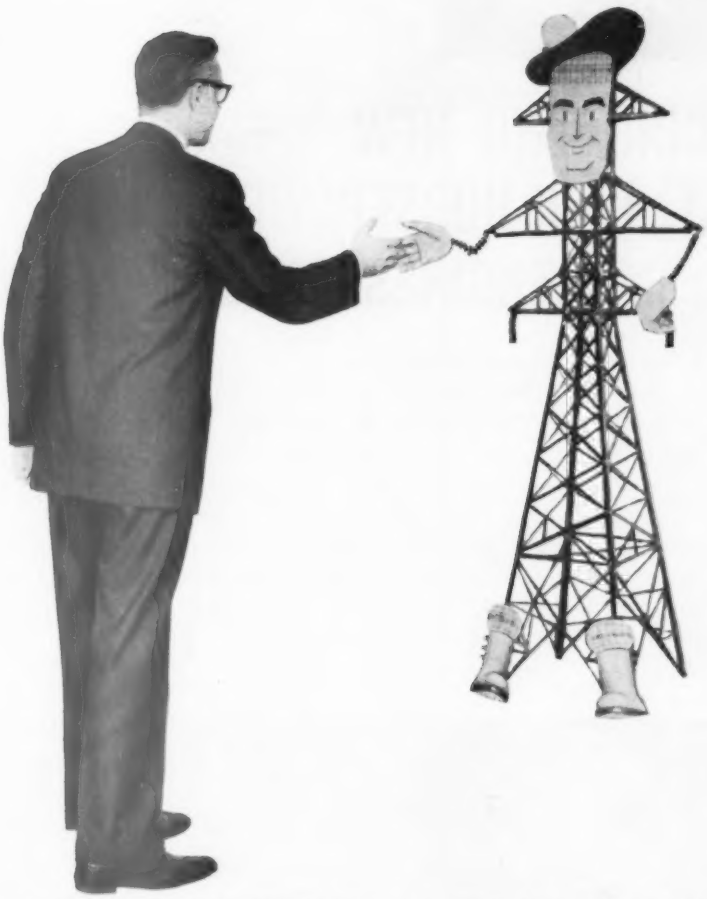
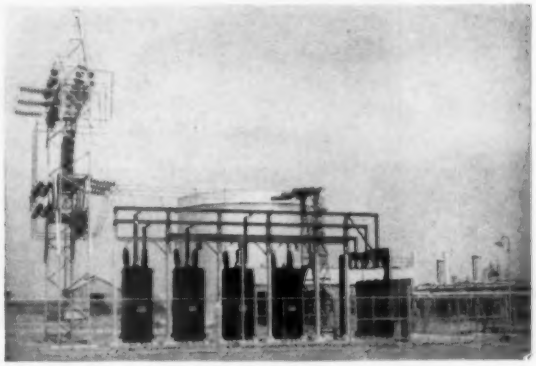
DIVISION OF THE DOW CHEMICAL COMPANY

Memo to Management:

STOP WASTE...
with efficient power



The increasing availability of utility electric power has made it more and more useful in the current drive to stop waste of time, money, and manpower. The many economies of utility electric power have made it the ideal solution to problems in pumping, waterflooding, gathering, transmission as well as refining. For the latest facts on purchased electric power, consult your Utility Electric Power Company.



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engine power
BY CATERPILLAR

ANNOUNCING TWO NEW LOW-COST, HIGH-HORSEPOWER NATURAL GAS ENGINES BY CATERPILLAR

These new Cat Natural Gas Engines are big in power—for drill rigs, pipeline pumping, compressing stations, separating plants—but low in initial price and in operating costs. They're as thrifty with space and weight as they are on dollars. In fact, the V12 G398 is about the same size as most V8s.

Both come in 7:1 and 10:1 compression ratios. You can operate them with most gaseous fuels.

Both engines use twin turbochargers and divided aftercoolers for greatest performance with top efficiency. They're also available as naturally aspirated gas engines. There's a lot that's new and important about these engines. Your Caterpillar Dealer or your equipment supplier will be happy to tell you about them. Get in touch with them today or write directly to us.

THE 480 HP G379

This new Caterpillar V-8 Natural Gas Engine develops 480 HP @ 1300 RPM. It has an electric set output of 300 KW.

THE 720 HP G398

This new Cat V12 Natural Gas Engine is rated at 720 HP @ 1300 RPM. It has an electric set rating of 450 KW.

CATERPILLAR Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A.

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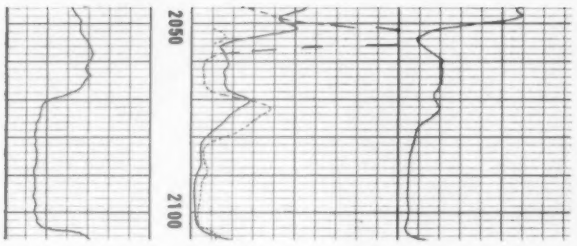
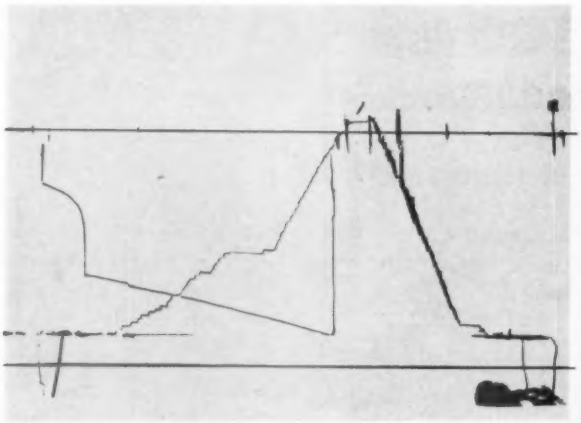
WHICH WELL WAS THE PRODUCER?
#2

WELL "C"

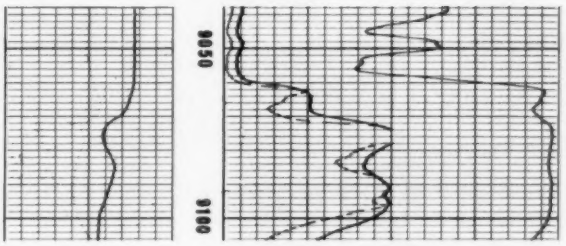


This rank wildcat was drilled to 6122'. Log analysis showed one interesting zone at interval 2068'-2080', and core analysis revealed 20% porosity with 70.5% fluid saturation (14.5% oil, 56.0% water). Both core analysis and logs indicated a transition at 2081'. Would you set casing on this well? Before reading further, study log and core information on well "D".

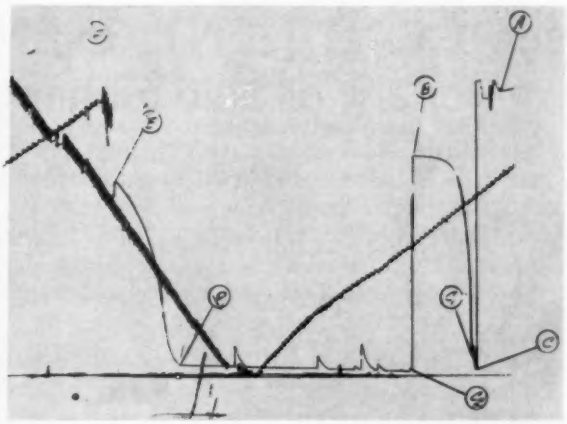


It was determined that much more conclusive data was needed before making a firm decision regarding completion of this well. Johnston Testers performed a selective zone test recovering 120' mud-cut oil, 1050' free oil and 40' salt water.

WELL "D"



Electric logs on this step-out well revealed the expected zone at interval 9066'-9092'. Log curves showed favorably. Analysis of cuttings showed an average porosity of 12% and 42% fluid saturation. Would you set casing on this well? Now study the drill stem test data on both Well "C" and Well "D" for the real answer.



Information obtained to this point showed favorably for a producer. However, a decision was made to get additional data prior to setting casing. Johnston Testers performed a 3-hour drill stem test recovering 300' of water and mud-cut water.

Well "C" became the producer flowing 90 barrels of pipeline oil daily. Well "D" is proof of the value of a Johnston drill stem test prior to setting casing. A decision based on logs and geological data alone could have been very costly. The operator of Well "D" stated that he was prepared to set 7" casing, perforate and treat the zone, and further, that the D.S.T. saved him approximately $15,000 to $20,000 . You can save thousands of dollars, too! Call Johnston Testers on your next well.

JOHNSTON TESTERS

Houston, Texas • Calgary, Canada

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Your time is too valuable to waste in searching for the right oil field rubber products. That's why your Continental store normally keeps the industry's broadest inventory, from stuffing box rings to rotary hose. And for unusual-application items, convenient field warehouses *eliminate needless waiting* for shipment from distant points.

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Check your requirements for oil field rubber goods. Then insist on the best — NYB&P, sold *exclusively* through Continental. You'll save time by making your *first* stop the *only* stop . . . at the store with the big Green Triangle.

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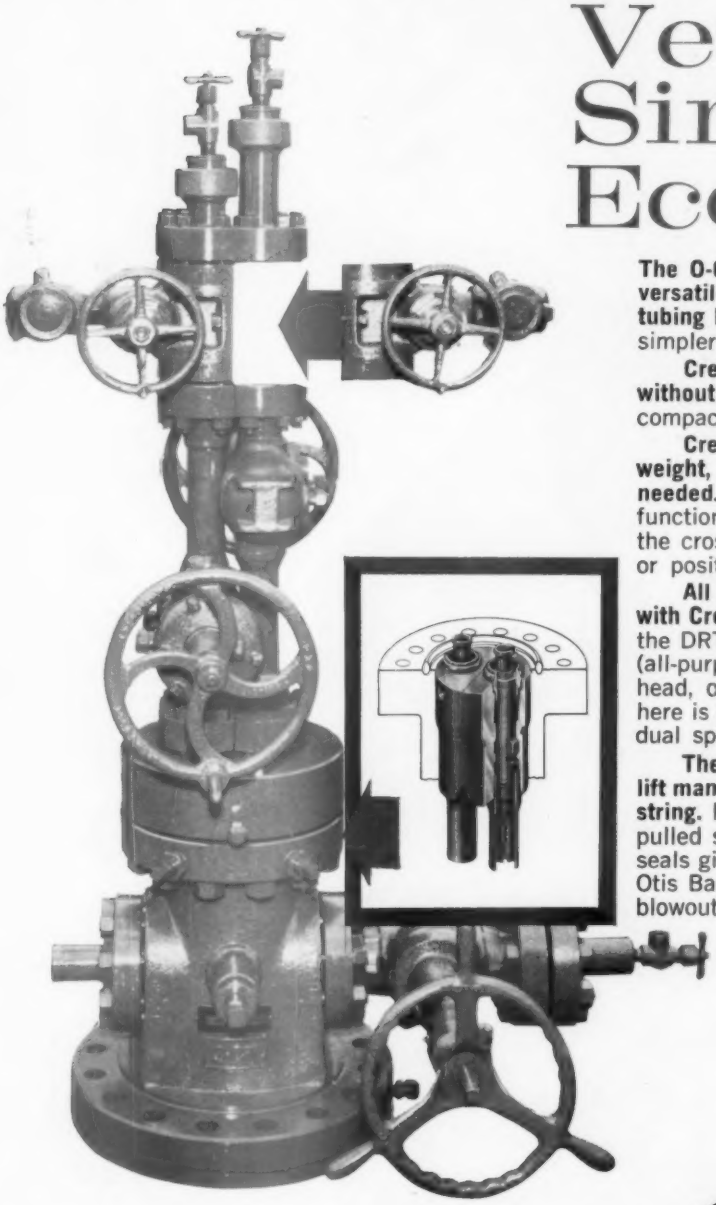
O·C·T Crescent Flange Trees GIVE YOU Versatility Simplicity Economy



The O-C-T Crescent Flange Tree combines versatile Crescent Flow Controls with O-C-T dual tubing heads to make dual completions simpler and more economical than ever.

Crescent Flanges let you remove either valve without disturbing the other. They are more compact and more economical than block valves.

Crescent Flow Controls reduce cost, weight, and the number of connections needed. They combine in one-piece units all functions of a single-wing tree, replacing the cross or tee, wing valve, and adjustable or positive choke.

All O-C-T dual tubing heads can be used with Crescent Flange Trees. These heads include the DRT (dual tension head), the TC (all-purpose head), the tubingless completion head, or the U-60 (universal head). Illustrated here is the U-60 tubing head with the U-60 dual split hanger.

The dual split hanger permits running gas lift mandrels or packer receptacles on either string. Each semicircular hanger can be run or pulled separately. Compression-type hanger seals give automatic annulus packoff, and O-C-T Otis Back Pressure Valves give complete blowout control after tubing has been landed.

These features provide compact, low-cost, dual-completion well heads that permit producing several zones to depletion without major well-head changes.

See your O-C-T representative for further information, or write directly to O-C-T.

where progress is a daily practice

O·C·T

OIL CENTER TOOL CO.

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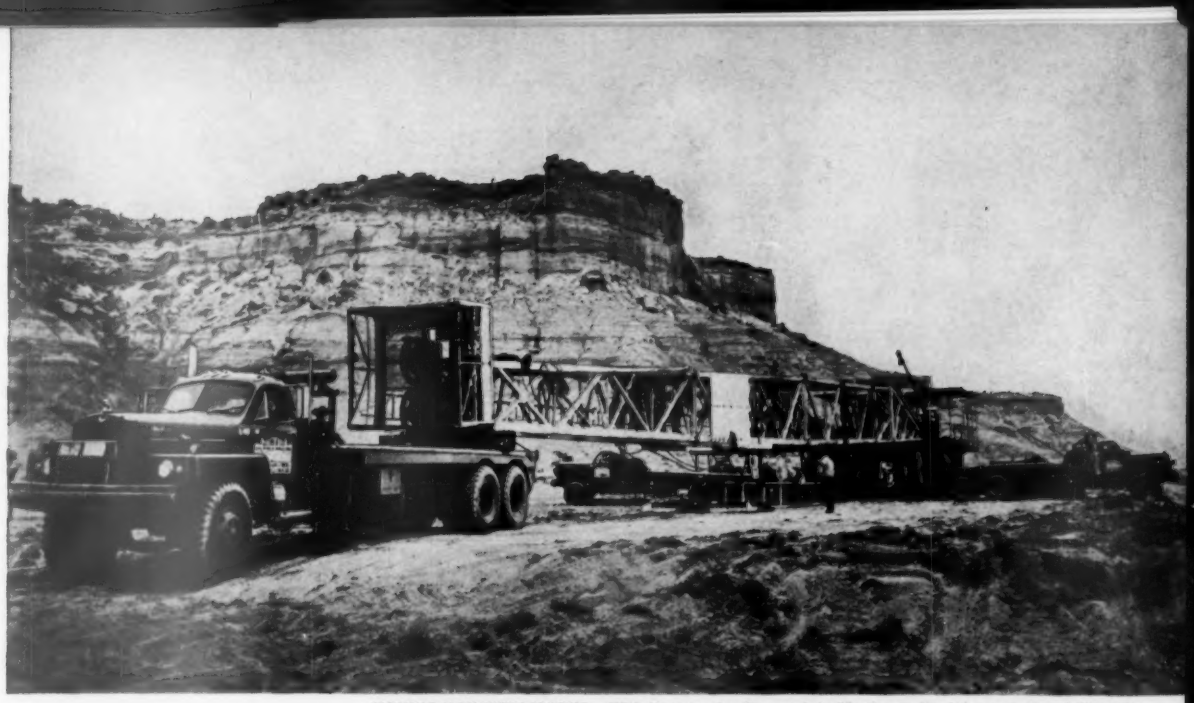
MACKS MAKE THEIR OWN ROADS. Fewer delays mean more profits.



MOVING DAY WITH MACKS—With three extra-heavy-duty Macks on the job, an entire drilling rig is transferred from one site to another in a matter of hours instead of days. Ability of Macks to handle big loads fast means more profitable operation.

"We make more money with Macks!"

Earning dependable profits in oil-field hauling depends in good part on using the most dependable trucks. Alton H. Lee, Inc., oil-field transporter of Farmington, N. Mex., has experienced unequaled vehicle earning power since its first purchase of Macks in 1955 and now operates a predominantly Mack fleet.

"Our Thermodyne® diesel-equipped Macks operate up to 36 hours on only 90 gallons of fuel, hauling 100-barrel oil and water tanks over some of the roughest terrain in this part of the country. And in winter they cost us as little as $100 a month maintenance," says Mr. Alton H. Lee, company president. "I call that economy!"

"Our latest B Model Macks are following the pace set by our other Macks. They haul complete drilling rigs and draw works—often through the worst winter weather over roads that are often extremely poor—with very little time-consuming breakdown," says Mr. Lee.

For trucks that can make more money for you, take a leaf from the books of operators like Alton H. Lee, Inc., whose performance records prove that Macks are consistently top earners. Your Mack branch or distributor will gladly supply facts and figures. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

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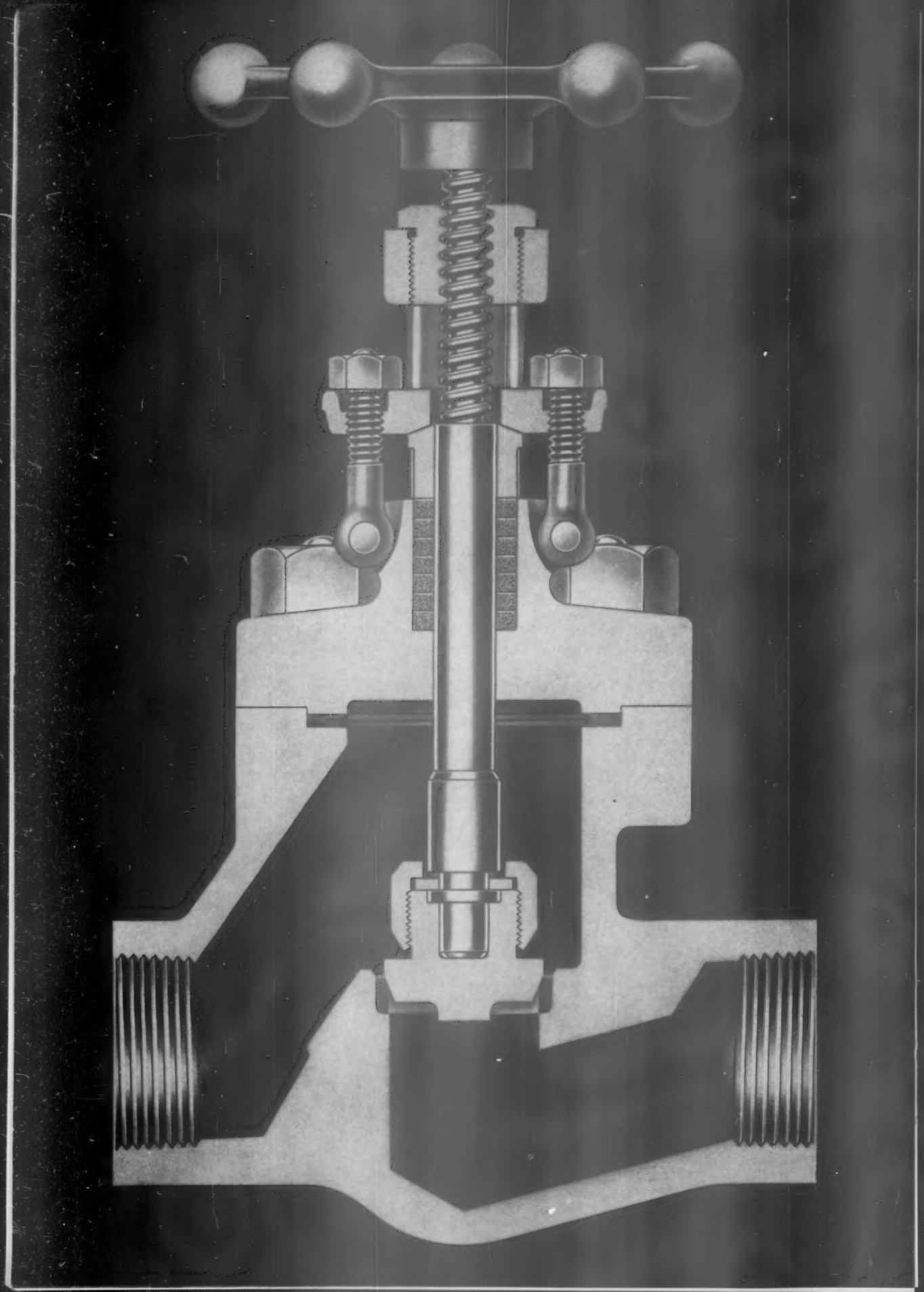
MACK
FIRST NAME FOR
TRUCKS

TRUCK-TESTING LOADS—Loading a draw works puts a tremendous strain on a truck chassis—here, over 100,000 lbs. on the rear axles alone—but Macks are built with the brawn to take this kind of punishment consistently without failure. Absence of mechanical breakdowns with Macks means more earning time on the job.

MACK
for over 8 straight years
NO. 1
by far in sales of diesel trucks



You can tell a quality valve by the attention it doesn't need

A $25.00 valve seldom seems important yet frequently is responsible for the protection of $100,000 of equipment and material . . .

Hancock Steel Valves are especially engineered and produced to operate dependably under unusual conditions of pressure, temperature, and fluid flow. A wide variety in alternate trim, body, and bonnet materials provides for attention-free, economical service in many different industrial and defense applications where downtime can be costly. Hancock Steel Valves have that extra measure of quality that only a leader can incorporate . . . the extra quality needed to protect processes, power generating nuclear systems, and missile launching equipment.

The valve illustrated at the left is the Hancock Type 5500 Steel Globe Valve widely used for all types of industrial plant services.

For technical assistance in selecting quality Hancock Steel Valves, phone your industrial supply distributor or write for Catalog 200A.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

HANCOCK Steel Valves

A product of

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Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
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Superior corrosion resistance with three new Johns-Manville Pipes

Epoxy-Lined Transite®

. . . for conveying aggressive process liquids.

- Excellent resistance to all salts in solution—both alkaline and acidic—and to most alkalies.
- Highly resistant to moderate concentration of organic, and to low concentrations of inorganic, acids.
- Full range of pressure pipe classes up to 200 psi.
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- Available in diameters of 6″ through 36″.
- Excellent flow characteristics.

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. . . the most economical corrosion-resistant piping available for hot processing lines.

- Rated for use up to 150 psi systems. Rated temperatures up to 300 F.
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- Homogeneous wall . . . no wall liners.
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- Can be steam-cleaned.
- Can be joined by adhesive bonding. Comes in 1″ through 6″ diameters.
- Asbestos-reinforced thermosetting resin product with excellent flow characteristics.

New ABS* Plastic Pipe

. . . ideal for use in transporting industrial chemicals, natural gases, irrigation water, salt water and sour crude.

- Exceptional corrosion resistance.
- Low friction loss.
- Free from electrolytic action.
- Pressure rated up to 140 F.
- Semi-rigid thermoplastic pipe.
- Comes in ½″ through 3″ diameters.

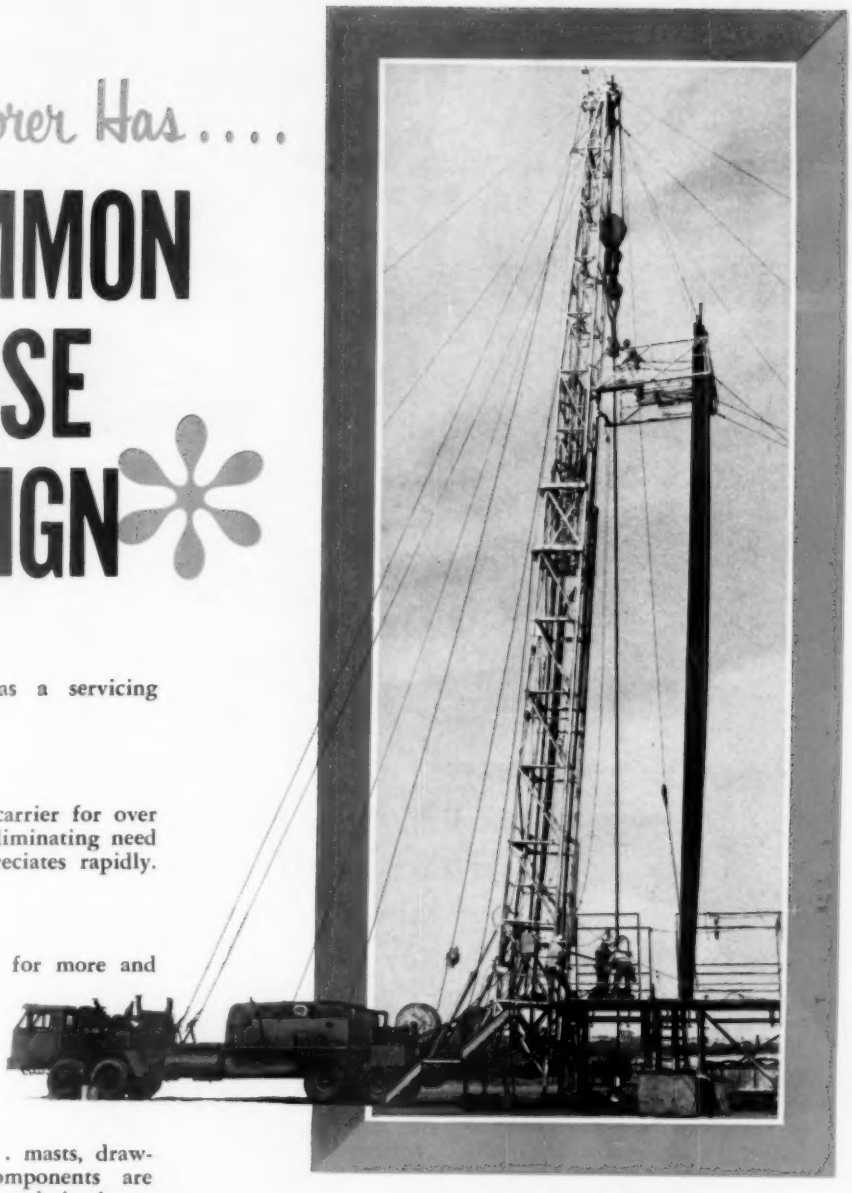
**acrylonitrile-butadiene-styrene*

JOHNS-MANVILLE PRODUCTS

JOHNS-MANVILLE

Franks Explorer Has....

COMMON SENSE DESIGN



CSD...

Primarily designed as a servicing and workover rig.

CSD...

Mounted on rugged carrier for over the road travel . . . eliminating need for truck which depreciates rapidly.

CSD...

Industrial horsepower for more and faster work.

CSD...

Greater flexibility . . . masts, drawworks and other components are interchangeable. Your unit is always up-to-date.

More Franks Explorers are sold than any other competing make — pretty good proof that the Franks Explorer **packs more punch!** Ask your Franks Representative for the facts.

WELL SERVICING AND DRILLING UNITS

FRANKS

PAMPA, TEXAS

CABOT

CABOT CORPORATION
MACHINERY DIVISION

Worth more when you BUY 'EM . . . Worth more when you TRADE 'EM

New Drilling Detergent Saves Drilling Dollars

D-D®, Magcobar's new drilling detergent, is recommended only for operators and contractors who like money. Because, when you use D-D on your well, it's hard **not** to save money.

Look what D-D does. By reducing surface tension in water base muds, it speeds up the rate of penetration. What's more, it settles out sand, extends the use of low pH muds to greater depths, and reduces costs of chemical treatment.

The really big surprise about D-D is that so little does so much. Initial treatment is only ten gallons per 500 barrels of drilling fluid. Maintenance is two to six gallons per tour.

Like money? You can learn all about D-D by writing for the new brochure. Magnet Cove Barium Corp., P. O. Box 6504, Houston, Texas.

Another **Well Done** with Magcobar Technology

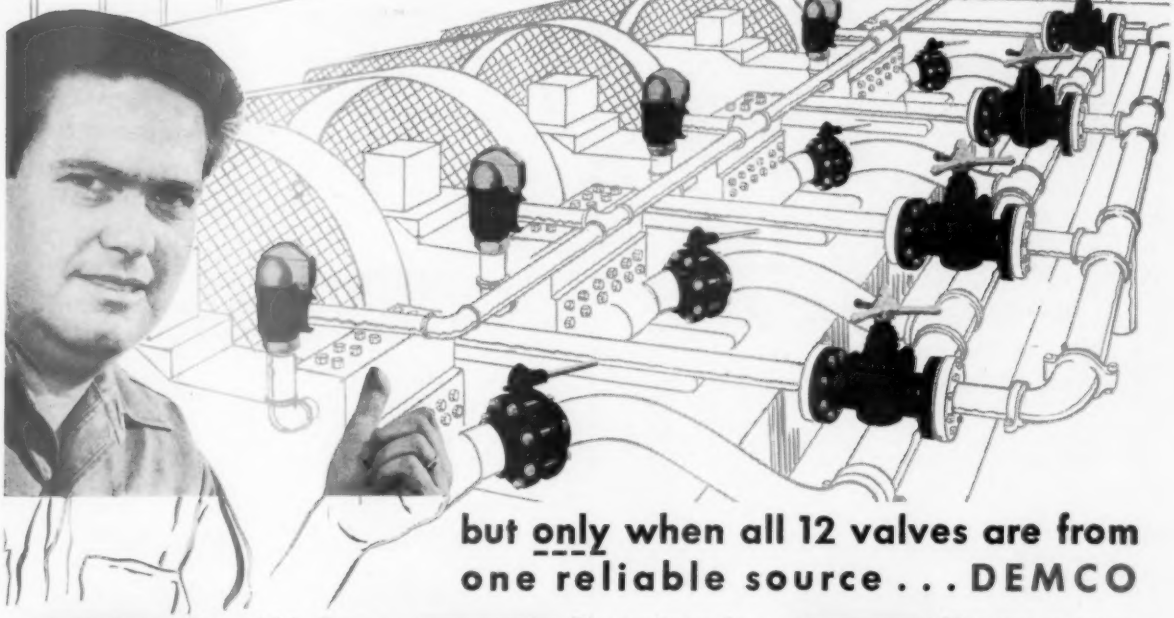
®Registered trademark, Magnet Cove Barium Corporation.

Magcobar
Completes
DRILLING MUD SERVICES

DRESSER INDUSTRIES, INC.
OIL • GAS
CHEMICAL
ELECTRONIC
INDUSTRIAL

equation for efficient operation:

3×4=1



but only when all 12 valves are from one reliable source . . . DEMCO

Dependable Demco Safety Relief Valves provide maximum protection against excessive pump and line pressures and offer the ultimate in safety to workers. Built-in safety cap encloses shear bar and nail, yet opens instantly when line pressure shears the nail. Advanced Demco design insures immediate relief from excess pressure by use of a *single* nail for *all* relief settings on the shear bar. Available in standard cast steel valve and sub-assembly or non-corrosive bronze valve with stainless steel sub-assembly.

The exclusive features of Demco Butterfly Valves offer bubble-tight seals in pressure or vacuum applications for liquids, vapors, or solids. The Demco disc "floats" on the stem, without set screws or exterior fastenings, and finds its true center for a positive, non-directional shut-off. A one-piece Buna-N seat, bonded to steel, provides a stronger, larger contact area for disc, acts as stem packing and eliminates needs for gaskets or "O" rings between flanges. Only the Buna-N synthetic seat and corrosion-resistant metal disc are exposed to line flow. Factory tested in excess of working pressure, Demco Butterfly Valves offer quick in-line repair.

You can count on longer, trouble-free valve life—and, a *drop-tight* seal every time—with the rugged, corrosion-resistant Demco Gate Valve. Exclusive spread-ring seat construction gives you a *positive* rubber-to-metal seal without undue stem torque—durable, synthetic Buna-N against corrosion-resistant stainless, Monel, aluminum bronze or steel. Entire inner assembly lifts out for faster, easier *in-line* inspection. With Demco's unique design, fewer parts are subject to wear. Stem threads are self-lubricated and protected from corrosion by a *double* stem seal.

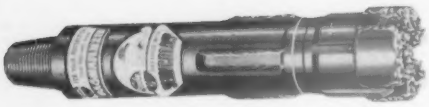
Wherever durability, reliability and safety are essential, on drilling and production installations all over the world, rugged Demco Valves have proved to be the answer. Choose all three or just one—but choose Demco!

All valves available in popular sizes and pressures at supply stores everywhere. Write Demco today for complete engineering details!

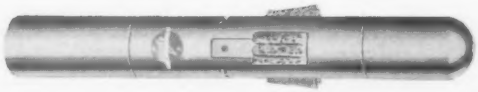
DRILLING EQUIPMENT MANUFACTURING COMPANY
834 S. E. 29th Street • Oklahoma City, Oklahoma

SERVCO TOOL GUIDE

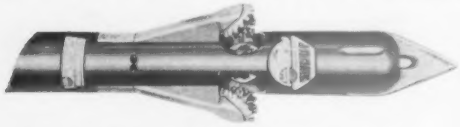
8 ways to lower drilling costs



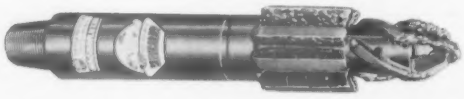
JUNK MILLS Tough, rugged tools for chewing up bit cones, packers, drill pipe, junk of all kinds—at rates that make fishing uneconomical.



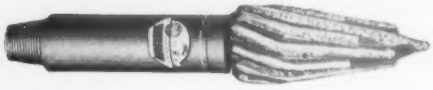
SECTION MILLS Mill any length section at rates up to 4′ per hour. Often complete window cut with one set of arms. Mill all weights of casing from 5″ to 13⅜″ O.D.



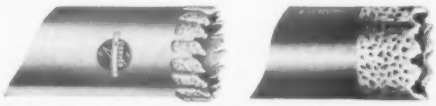
HOLE OPENERS *Rock Bit Type:* Opens hole up to twice the bit diameter in hardest formations. Also, *Blade Type* increases hole diameter up to 17″, simultaneously with drilling, in soft to medium formation.



PILOT MILLS Mill wash pipe, casing, liner, liner hanger, drill pipe or tubing at rates up to 10′ per hour; drill collars up to 2′ per hour. The perfect tool for swaged casing completions.



TAPER MILLS Mill collapsed casing, enlarge holes through adapters or retainers, mill out dented casing, and for general reaming.



ROTARY SHOES Difficult washover and milling jobs completed in a fraction of the time required by conventional shoes. Tooth type to cut formation; perforated type to cut iron and formation.

REAMER-STABILIZERS Keep hole to gauge in the roughest, sharpest sands. Save rig time and money by eliminating double drilling and separate reaming operations. SERVCOLOY "W" resists wear 5 to 10 times better than conventional hardfacing.

STABILIZERS *Welded Blade Type:* rugged, low cost tools with welded wrap-around wings. *Model "B":* Replacement wings quickly changed without removing body from string. SERVCOLOY "W" makes tools last 5 to 10 times longer than conventional hardfacing.

SERVCO tools make downhole milling and drilling safe and economical. The secret of their phenomenal performance lies in the amazing material called *Servcoloy*. Developed by SERVCO and protected by patents, and constantly improved through research and field usage, *Servcoloy* fully utilizes carbide's cutting properties while overcoming its inherent brittleness. Are you profiting from its use? Your SERVCO representative will be glad to tell you how. Call him today.

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Photographed at DX Sunray, (Tulsa Refinery)

For higher yield...new Aerocat 3C

CAN YOU USE a higher yield of gasoline—? or of propylenes or butylenes—? Then investigate the new AEROCAT 3C! It's a new fluid cracking catalyst composition, developed by Cyanamid in cooperation with a major oil company. AEROCAT 3C-12 gives increased gasoline yield . . . AEROCAT 3C-20, increased propylene and butylene yields . . . both at the expense of dry gas and coke.

In actual commercial operations, these new three-component catalysts have proved their ability to provide refiners with more flexible, more profitable operation. They are highly active, exceedingly stable, and completely operative.

Your "Man with the Golden Rule"—your Cyanamid salesman—will be glad to work with you to determine the suitability of AEROCAT 3C for your needs. He knows catalysts—and behind him are the resources of a major producer of both catalysts and other chemicals. Why not call him now?

Basic in catalyst chemistry

CYANAMID

AMERICAN CYANAMID COMPANY • REFINERY CHEMICALS DEPARTMENT • 30 Rockefeller Plaza, New York 20, New York

NEW BARTON 273 PNEUMATIC TRANSMITTER MEETS MORE APPLICATION REQUIREMENTS THAN ANY OTHER TRANSMITTER

The Barton 273 offers the widest differential pressure ranges (0-8″ w.c. to 0-400 psi), the highest safe working pressures (to 10,000 psi), and the widest variety of housing materials (aluminum, brass, steel, 316 stainless steel). It's compact, weighing up to less than ½ the weight of other units. It has adjustable suppression up to 80% of DP range, and adjustable span. A non-bleed relay minimizes air consumption. It doesn't shift zero on overrange. It's unaffected by normal piping stress. In every respect, the Barton 273 is the most significant advance in pneumatic transmitters in the past decade. There's a lot more you should know about it—for complete data write

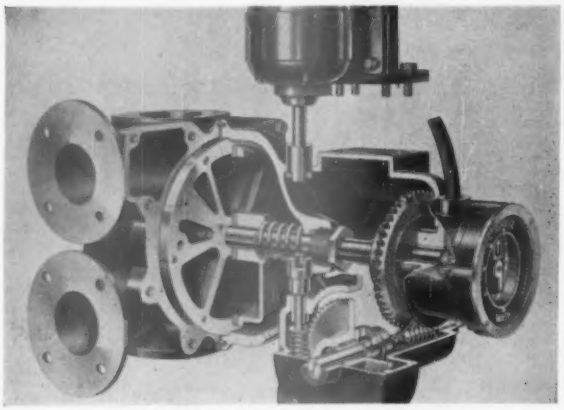
BARTON

INSTRUMENT CORPORATION, 580 MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA.

SILICONE NEWS from Dow Corning

Leak-Proof Valve Lube

Chemical Resistance. A large Southwest petrochemical plant depends on Dow Corning Valve Seal to prevent sticking and leakage in hundreds of angle and safety relief valves on railroad tank cars . . . other valves throughout the plant. Inert Valve Seal won't react with or contaminate such chemicals as ethylene and propylene oxides, ethyl, methyl and vinyl chlorides, butylene and butadiene. In process plants, too, silicones help prevent corrosion . . . speed operations and ease teardown of equipment.



Water Repellency. Between rubber and bronze mating faces of valves in water conditioning equipment, this grease-like silicone compound provides an effective, leak-proof seal. With superior water resistance, the silicones protect parts from corrosion . . . increase service life and reduce maintenance. Silicones offer additional advantages: won't react with chemicals passing through ports, won't attack rubber or plastic parts, remain near-constant in viscosity in extreme temperatures.

Inert Silicone Compound Cuts Valve Maintenance

For a long lasting valve lubricant . . . specify Dow Corning Valve Seal, a non-melting silicone compound that remains grease-like from —40 to 500 F. *Chemical resistance . . . heat stability . . .* and *water repellency* are just three of many reasons for using Valve Seal. *Inert* and *nonoxidizing*, it offers advantages in numerous applications . . . on outside lines . . . in low temperature processing . . . on delicate equipment and recording instruments.

Heat Stability. From —40 to 500 F, Dow Corning Valve Seal stays on the job . . . won't melt, run off or gum up. This excellent thermal stability helps assure tight packing seals on shafts of seven 2-speed mixers in a hydrocarbon section where temperatures range from 10 to 200 F. In the mixers where cuprous ammonium acetate and butadiene are combined, nonreactive silicones keep a tight seal and prevent contamination in the lines. Dow Corning Valve Seal also provides excellent resistance to oils and oxidation.

Inert, Nonoxidizing. In contact with most chemicals or oils . . . in high heat or cold . . . in hot water or low-pressure steam . . . Dow Corning Valve Seal has been proved successful as a sealant, and lubricant. Applications include plug valves, control valves, flow meter bearings, plugcocks . . . other assemblies . . . pump packing impregnation. Valve Seal is available in 2-ounce and 8-ounce collapsible tubes, and in bulk containers of 10 pounds and 50 pounds. Investigate today.

For complete data on all silicone products, contact the Dow Corning office nearest you. Address Dept. 6217a.

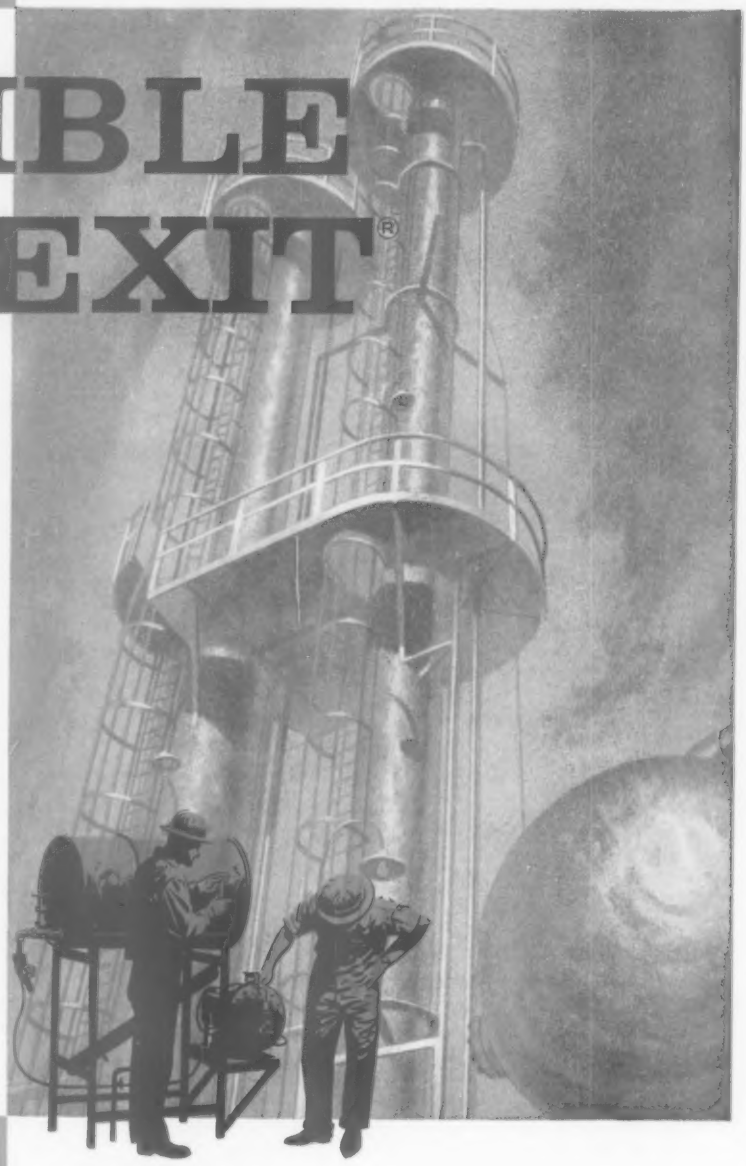
first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

98% protection* against internal corrosion

HUMBLE COREXIT®



* *Ten years of measurements* in refineries and gas plants prove its high efficiency and economy. For as little as 50¢ per thousand barrels of throughput, Humble COREXIT prevents internal corrosion in pipe still overhead, distillation towers, vapor recovery systems and other refining units. Equipment life is extended, you make longer runs between turn-arounds, and down time is reduced. *COREXIT makes important savings in every refinery and gas plant where it is used.* For complete information on technical services and COREXIT formulations to meet your specific requirements, see your Humble salesman or contact Humble Oil & Refining Company, Houston, Texas.

HUMBLE

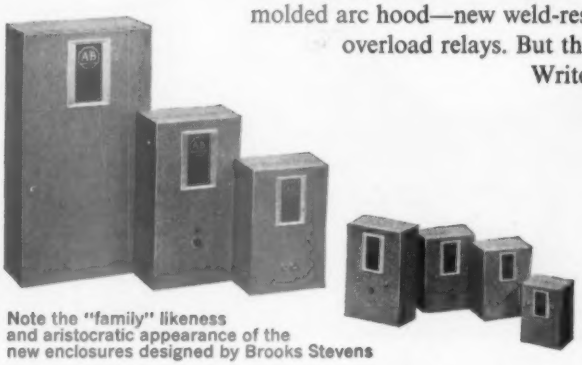
America's Leading ENergy COmpany

a complete NEW family of Bulletin 709 Motor Starters

A-B QUALITY

the greatest advance in motor control in 30 years

From their amazing compactness to their almost unbelievable operating life—measured in *millions* of operations—this entire family of Bulletin 709 solenoid starters is *new in every detail.* They feature a new, patented, high-efficiency magnet—new molded coil—new hot molded arc hood—new weld-resistant contacts—and new truly *trip-free* and *tamperproof* overload relays. But these new starters use the old Bulletin 709 heater elements. Write today for all the details on this really amazing new line of Allen-Bradley Bulletin 709 motor starters.



Note the "family" likeness and aristocratic appearance of the new enclosures designed by Brooks Stevens

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis.

Trinity
LITE-WATE

A Complete Low Density Cement with

EXCEPTIONAL COMPRESSIVE STRENGTH

Strength is recognized as one of the important qualities of an oil well cement slurry. TRINITY LITE-WATE cement develops exceptional compressive strengths.

In the range of lightweight cement slurries, TRINITY LITE-WATE produces a slurry which is:

1. Light enough to circulate.
2. Strong enough for any casing seat.
3. Strong enough to permit hydraulic fracturing.
4. Impervious to migrating fluids.
5. Sulfate resistant for lasting casing protection.

For TRINITY LITE-WATE cement call your service company.

For complete Laboratory Data call your local Trinity Representative or write Dallas Office, P. O. Box 2698 or phone RIverside 2-8111.

376 lb. Barrel 94 lb. Sack

75 lb. Dry Volume per cubic foot

TRINITY

PORTLAND CEMENT DIVISION
GENERAL PORTLAND CEMENT COMPANY

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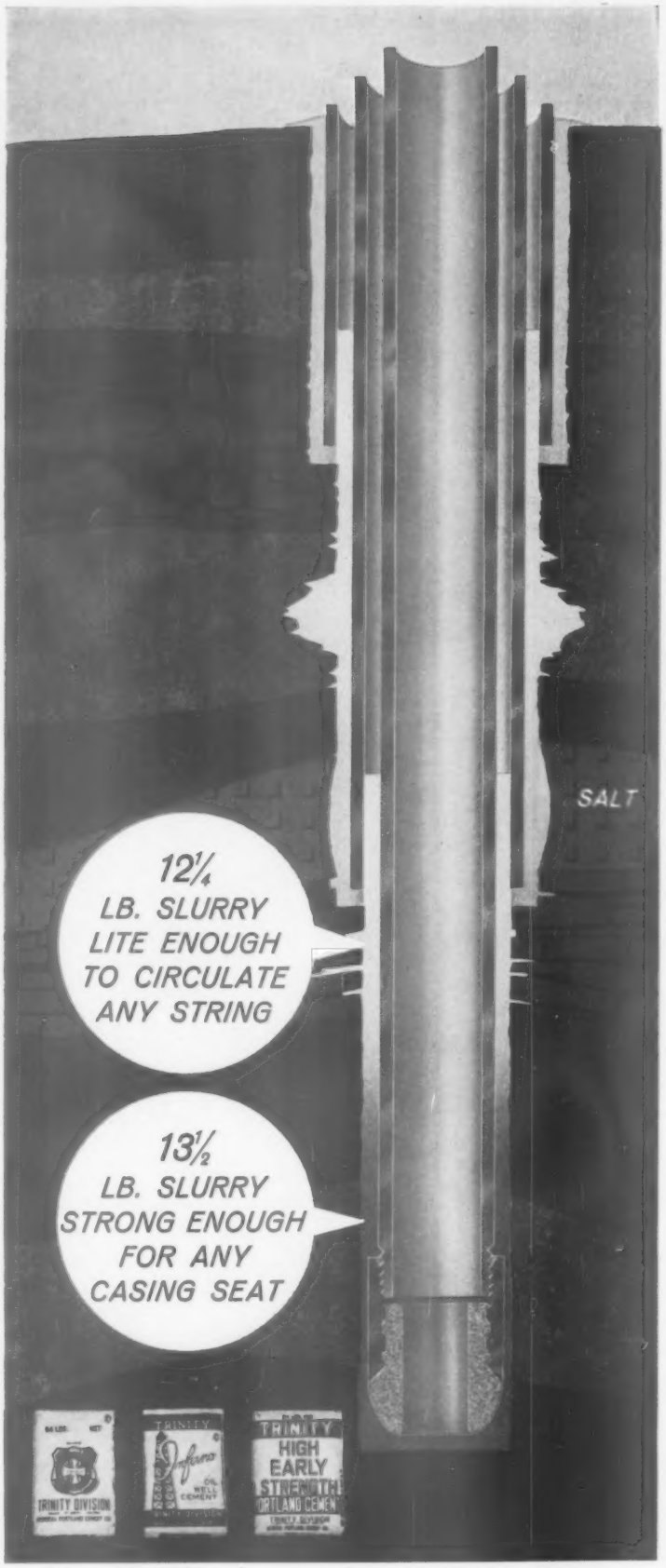
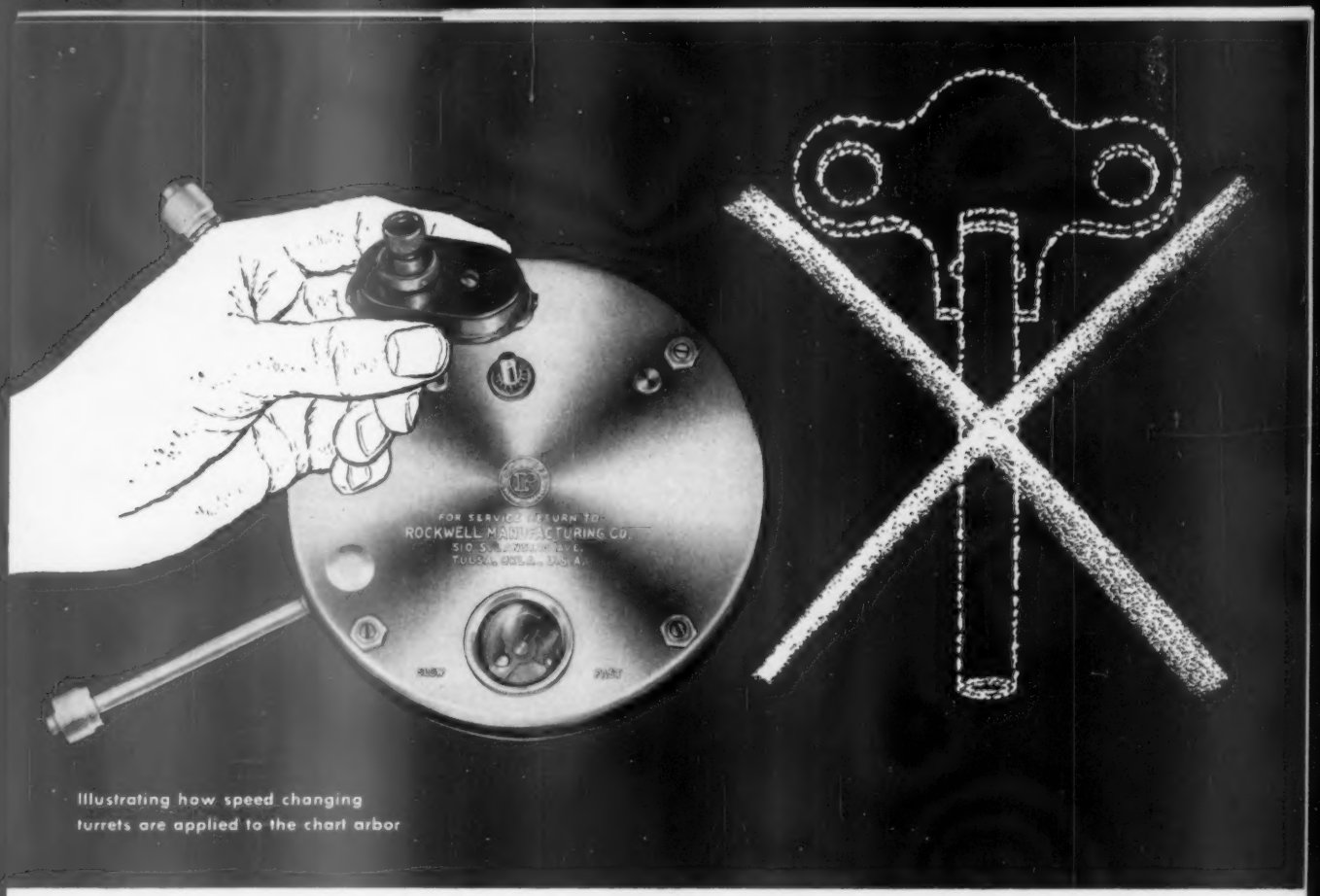




Illustrating how speed changing turrets are applied to the chart arbor

You never need to wind the Rockwell Gas Drive

GAS (OR AIR) POWERS THIS NEW CHART TIMING DRIVE. With it you can forget the costly chore of periodic winding. It's completely self-starting, self-contained. You can use the Rockwell Gas Drive with profit and gain accurate, automatic operation of recording charts on practically any make orifice meter, gas lift intermitter, pressure recorder or temperature gauge. It is particularly applicable for remotely located instruments.

Since the Rockwell Gas Drive consumes only 6 cubic feet of gas in 24 hours it is economical to use—safe, too, for there is no exhaust problem.

The Gas Drive operates on a pressure range of 15-25 psi and delivers 15 in. lbs. of torque to the main arbor which rotates once every 24 hours. Geared turrets which snap onto this arbor provide optional speeds of 2, 3, 4, 6, 12, 48 or 72 hour, 7 or 8 day rotation. So with a stock of Rockwell Gas Drives, plus a selection of economical turrets, you can serve all your instrument needs. Get facts now. Write Rockwell Manufacturing Company, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Guelph, Ontario.

◀ Rockwell Gas Drive powers this typical intermitter

GAS DRIVES, CHART DRIVES

another fine product by

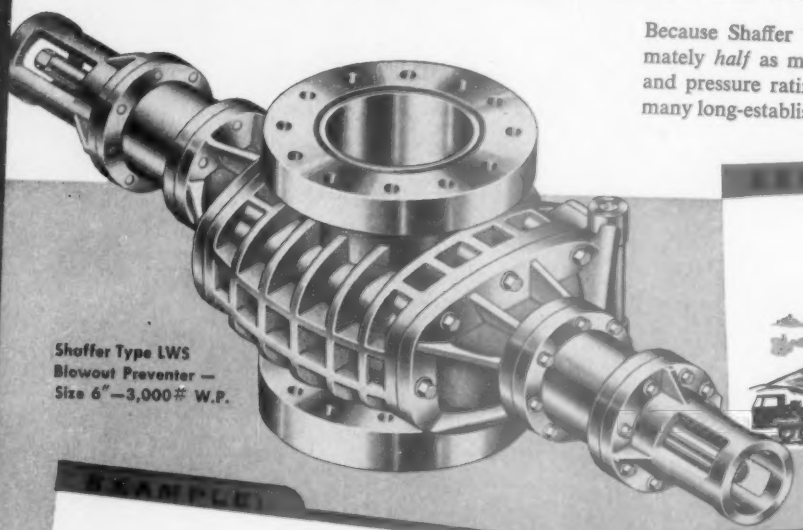
ROCKWELL

HALF THE WEIGHT...for Lower Shipping Costs!
HALF THE WEIGHT...for Easier Installation!
HALF THE WEIGHT...for Simplified Storage!

The Industry's First LIGHTWEIGHT Blowout Preventers

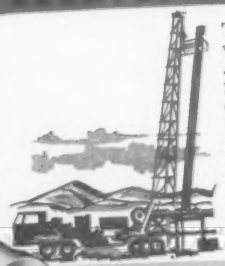
SHAFFER TYPE LWS BLOWOUT PREVENTERS

Because Shaffer Type LWS Blowout Preventers weigh approximately *half* as much as comparable equipment of the same size and pressure ratings, this Shaffer development is revolutionizing many long-established practices in the oil industry . . .



Shaffer Type LWS Blowout Preventer — Size 6"—3,000# W.P.

EXAMPLE

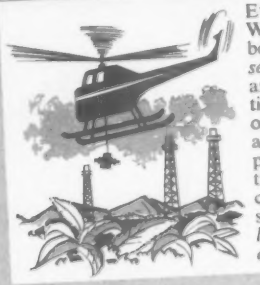


The 6"—3,000# W.P. Preventer weighs only 780 lbs. *(a 67% saving in weight)* and is ideal for protection on quick in-and-out production jobs where the heavy weight of other types of preventers make adequate pressure protection impractical on such operations. Result—*greater safety is now possible on all types of production and well rework jobs!*

EXAMPLE

On out-of-the-way rig sites where high transportation costs are a big problem, the 6"—5,000# W.P., 8"—3,000# W.P. and 10"—3,000# W.P. Type LWS Preventers with weight savings up to 64%, (see table below at right) are making possible major economies in shipping costs. Even on domestic wells, weight savings like these can mean the difference between using a big, costly truck or a small, inexpensive one—*plus additional savings in storage and handling costs all along the line!*

EXAMPLE



Even the large 10"—3,000# W.P. Type LWS Preventer can be readily transported, *fully assembled*, by normal air cargo and helicopter lifts, saving vital time and slicing costs in jungle or arctic operations where roads are non-existent or are so impassable during certain seasons that heavier types of preventers cannot be transported to the rig site. *But with LWS Preventers, losses in rig-up time are virtually eliminated!*

INCORPORATE THE LATEST SHAFFER ADVANCEMENTS—Although they are light in weight (made possible by a unique Shaffer "deep-rib" steel casting technique) Type LWS Preventers incorporate all the latest Shaffer advancements—advancements still not found on other preventers that weigh *twice* as much . . . **Swinging END-Opening Doors** for quick, simple ram changes without loss of operating fluid . . . **Positive "In-Line" Power Drive** with each ram and its operating piston on opposite ends of a *single* stainless steel shaft (no levers, yokes or other complex connections between the ram and its operating piston) . . . **Quick-Drain Ram Compartments** that prevent detrimental accumulation of mud and sand—*and many other important advancements found only in Shaffer Preventers!*

SEE your nearest Shaffer representative for complete data on the savings you can make with the *lightweight* Shaffer Type LWS Blowout Preventers. Or Write Direct!

FOUR POPULAR SIZES OF SHAFFER TYPE LWS BLOWOUT PREVENTERS

Nominal API Size	Working Pressure	Test Pressure	Vertical Bore	Approx. Weights		Approx. Saving in Weight*
				Single	Double	
6"—3,000# W.P. (6" Series 900)	3,000 PSI	6,000 PSI	7 1/16"	780 lbs.	1,420 lbs.	67 %
6"—5,000# W.P. (6" Series 1500)	5,000 PSI	10,000 PSI	7 1/16"	1,410 lbs.	2,610 lbs.	55 %
8"—3,000# W.P. (8" Series 900)	3,000 PSI	6,000 PSI	9"	1,100 lbs.	1,950 lbs.	64 %
10"—3,000# W.P. (10" Series 900)	3,000 PSI	6,000 PSI	11"	2,100 lbs.	3,850 lbs.	45 %

*As compared with comparable equipment now in use.

38 years OF OIL TOOL LEADERSHIP

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HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT - FISHING TOOLS THAT EXCEL

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They Say—

Mis-Stated

Dear Sir:

I was startled to see in the April 24 issue under the "25 Years Ago" heading (p. 57) that the then booming Rodessa field was credited to northwestern Oklahoma. It actually is in Louisiana, and with a little bit extending into Texas.

George A. Wilson
President
TXL Oil Corp.

No one's face is redder than the editor who wrote this April 24 item . . . it's the same man who, 25 years ago, covered the Rodessa boom for the Journal right on the spot . . . in Louisiana, that is.—Ed.

OGJ behind the iron curtain

Dear Sir:

Early in February Radio Free Europe's fund-raising organization received a copy of one of your news releases, titled "Free World Gets Cheap Russian Oil, But Communist Bloc Pays High Price" (OGJ, Jan. 16, 1961, p. 64). Your news release was of considerable interest to us and I wish to express through you our appreciation to the forwarder, J. A. Tucker of Tulsa.

I think that the story of this Oil and Gas Journal article—from its origins in Tulsa, through RFE New York and Munich offices, directly to the listeners behind the Iron Curtain—is worth telling.

As soon as RFE received your news release our New York newsroom issued the story as a "Special" report: this in turn was immediately transmitted to our five language programming desks and flashed to the Munich news center for use in RFE's on-the-hour newscasts. The story was subsequently presented in several commentaries, most notably to Bulgaria, Czechoslovakia, and Romania.

Although the general problem of the Soviet Union's discriminatory two-price system has been frequently discussed by RFE in the past, your particular story—pegged specifically to trade in oil—provided an inter-

BAROID OIL MUD SOLVES WATER

Baroid Field Report: Los Angeles County, California This case history exemplifies the application of

MUD PROBLEM:
To drill and complete in water-sensitive pay sands

WELL DATA

LOCATION: Inglewood Field, Los Angeles County, California
TOTAL DEPTH: 9,390'
BOTTOM HOLE TEMPERATURE: 275 F to 300 F

CASING PROGRAM

SIZE, INCHES O.D.	DEPTH SET, FEET
16"	550'
10¾"	3,000'
7"	8,975'

MUD ADDITIVE PROGRAM

550 to 3,000'	AQUAGEL*—caustic soda—CARBONOX* emulsion mud
3,000' to 7,400'	Water-base emulsion mud containing 10 volume percent oil, HYDROCARB* and TRIMULSO*
7,400'	Displaced the oil-in-water-emulsion mud with Baroid Oil Mud
7,400' to 9,390'	Drilled with Baroid Oil Mud containing INVERMUL*, PETROTONE** and DURATONE**

TYPICAL MUD PROPERTIES OF BAROID OIL MUD

Depth, ft.	7,414	8,150	9,390
Weight, lb/gal	10.8	11.6	12.2
Viscosity, sec	95	115	131
Filtrate, ml (oil)	0.0	0.0	0.5
Oil, % by volume	45	44	42
Solids, % by volume	15	21	22
Water, % by volume	40	35	36
Electric Stability, volts	220	230	220

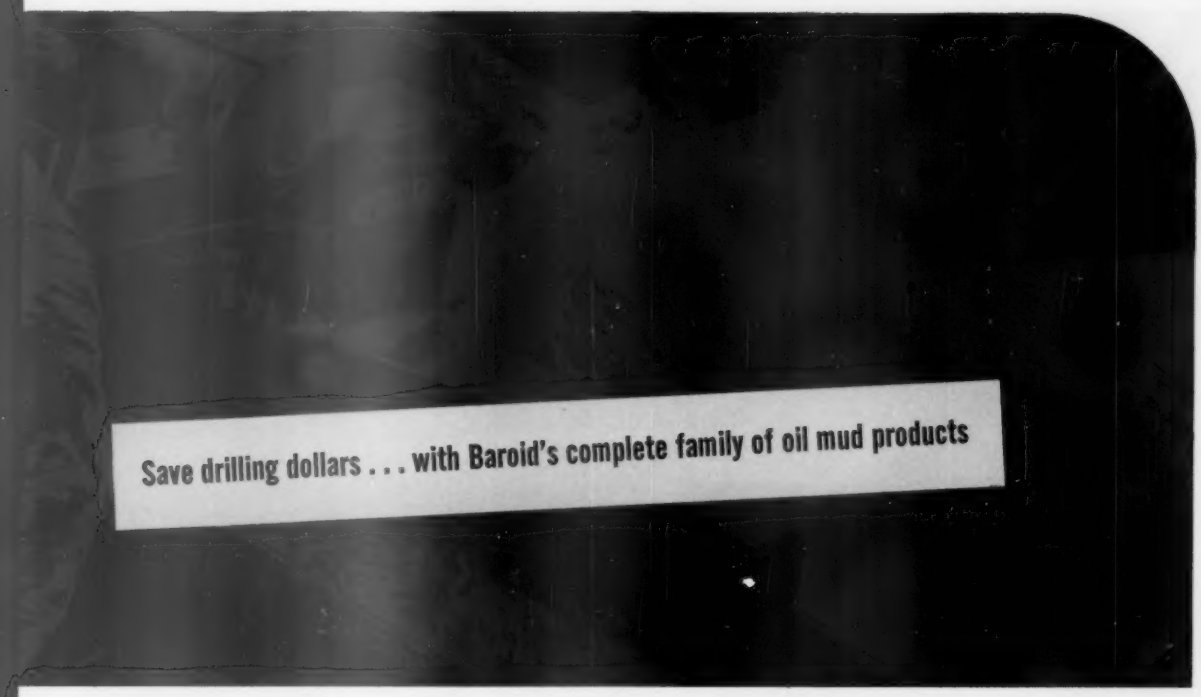
DISCUSSION: Water-sensitive formations and high bottom-hole temperatures below 7,500 feet in the Inglewood Field, Los Angeles County, California present a problem in the selection of a drilling mud. Formation damage is attributed to the filtrate from conventional water muds. To prevent formation damage and minimize hole enlargement Baroid Oil Mud was selected to drill the bottom 2000 feet of hole.

SOLUTION: The Baroid Oil Mud selected was pre-mixed with INVERMUL and DURATONE and used to displace the water mud at a depth of 7,400'. No difficulty was encountered during the displacement. Water mud incorporated into the INVERMUL-DURATONE Oil Mud did not alter its flow properties. To prevent settling of BAROID* as bottom-hole temperature increased (275 F to 300 F), the oil mud was treated with 2 lb/bbl PETROTONE. Filtration was maintained at 0.0 to 0.5 ml, all-oil, eliminating any possibility of water-wetting the formations.

*AQUAGEL, bentonite; CARBONOX, thinner; HYDROCARB, alkaline thinner; TRIMULSO, surfactant; INVERMUL, emulsifier; DRILOIL, oil mud concentrate; and DRILTREAT, stabilizer; are Registered Trademarks of Baroid Division National Lead Company.

**PETROTONE, suspending agent, and DURATONE, filtration stabilizer, are Trademarks of Baroid Division National Lead Company.

BAROID--*Still Pioneering Drilling Mud Research • Engineering • Marketing*



SENSITIVE PAY SAND PROBLEM

pe of Baroid Oil Mud used to solve this particular problem.

The Baroid family of oil mud products are INVERMUL, DURATONE, PETROTONE, DRILOIL® and DRILTREAT®. These products allow the operator to select an oil mud having properties suitable for the drilling problem. Such properties can also be modified by treatment if necessary. This approach has long been used in the selection and treatment of conventional drilling muds but is new to oil muds. This new approach to oil muds has resulted in their successful use for drilling, coring, completion, perforating, gravel packing, packer fluids, freeing stuck drill pipe, and for fishing.

In this case history in Los Angeles County, California, a Baroid Oil Mud was selected as the practical solution to the problem of drilling and successfully completing water-sensitive pay sands. At 7,400 feet an INVERMUL-DURATONE Oil Mud was used to displace the damaging water mud. This oil mud was treated with 2 lb/bbl PETROTONE to eliminate any possibility of settling of weight material as bottom-hole temperature increased. Drilling was trouble-free and completion successful.

INVERMUL, a free-flowing powder, the basic ingredient in this Baroid Oil Mud is an active, readily oil-dispersible emulsifier that stabilizes the emulsion and protects productive formations by controlling filtration.

PETROTONE is a dry powdered colloid that imparts solids-suspending properties to all types of oil muds — is easily mixed — treatment is nominal in cost. The usual amount added is 1 to 5 lb/bbl of oil mud. PETROTONE is stable at the highest bottom-hole temperatures presently encountered in drilling.

DURATONE, a unique organic colloid, controls filtration of all types of oil muds at the highest bottom-hole temperatures. The development of DURATONE and PETROTONE, as companion products to INVERMUL, has diversified and extended the application of oil muds. This is another example of how Baroid's customer-oriented program of research and engineering saves you drilling and completion dollars and keeps your operations on schedule.

BAROID

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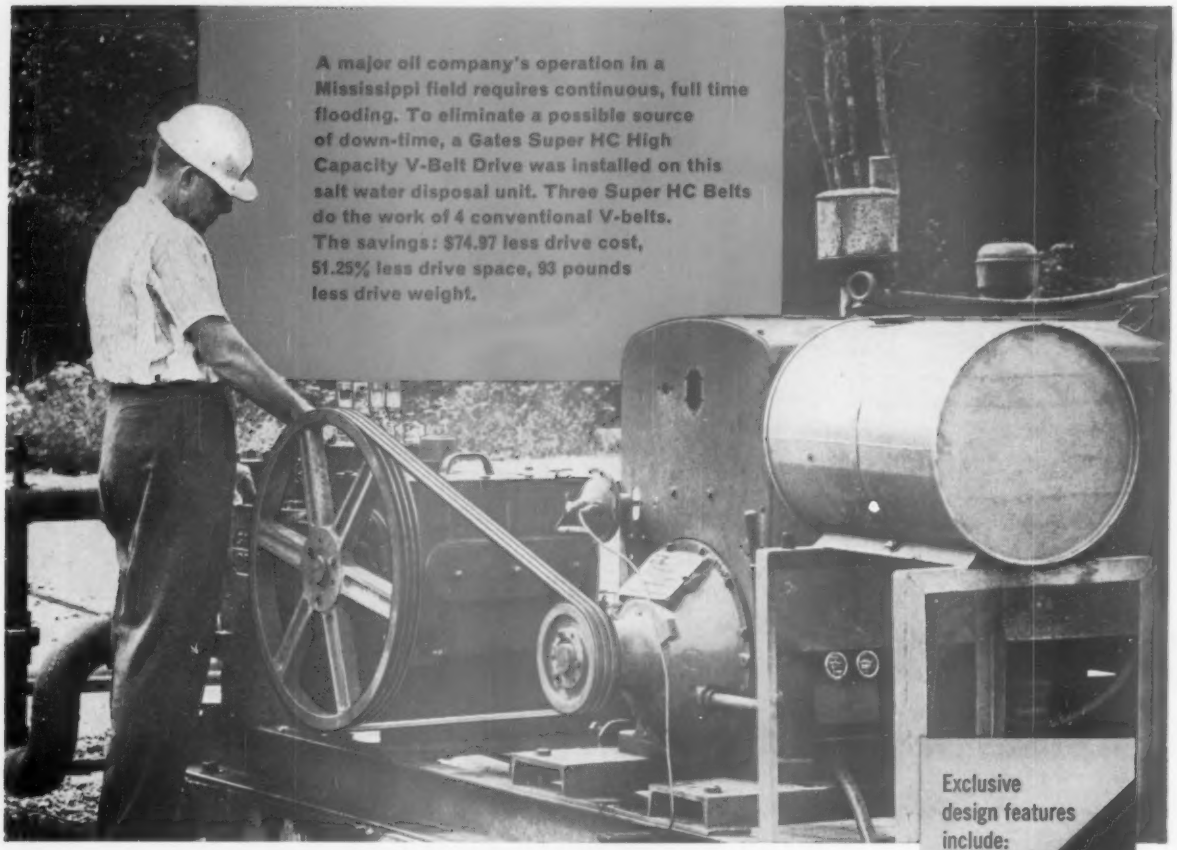

A major oil company's operation in a Mississippi field requires continuous, full time flooding. To eliminate a possible source of down-time, a Gates Super HC High Capacity V-Belt Drive was installed on this salt water disposal unit. Three Super HC Belts do the work of 4 conventional V-belts. The savings: $74.97 less drive cost, 51.25% less drive space, 93 pounds less drive weight.

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The Gates Rubber Company, Denver, Colorado BP 24

Gates Super HC V-Belt Drives

Gates

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esting and documentable new slant for program coverage.

Incorporating statistics from your article, RFE broadcasts underlined the unjust inconsistencies in Soviet trade policies, once again breaking through the Iron Curtain with news of vital concern to the people in our target areas — Poland, Czechoslovakia, Hungary, Bulgaria, and Romania.

Our thanks to your publication for its most interesting analysis of this aspect of Soviet-satellite relations; I hope that you share my pleasure that this most pertinent commentary has been carried to thousands of Iron Curtain listeners whose greatest source of just news continues to rest in the Western broadcaster.

Margaret M. Conroy
Office of Public Information
Radio Free Europe

Ideas needed, and soon

Dear Sir:

It seems as if the gas industry desperately needs a small body of competent, experienced businessmen to speak for the masses, and to present its views and ideas to the governing bodies in Washington. Could a plan be devised so as to ascertain the desires and needs of as many gas producers as possible and from there arrive at a method of determining the price of gas? Could a method be found by the questionnaire route?

A small group of men must do this, and seemingly very soon. If Congress solves part of the problems, it will attempt to solve them all, and the gas industry will be completely at its mercy. All producers possibly know what price they need to insure future success.

One possible yardstick or measuring device to be used would be a certain per cent return on their investment. This is far from being a new approach, yet, carry the device one step further, and set up standards of accounting procedure, the same for all producers, and let these standards be the basis for determining percentage figure of return.

This device may mean a change of accounting methods in some if not many companies, but a change there would be much easier than to change a governmental policy once established.

The gas industry is in the same category as the drilling contractor. It does no present a solid front with the solid backing of all concerned. A group, completely unified and having the support of gas producers, must present a method to the FPC—a new method, a workable method—with which to set gas prices.

Will I. Lewis, Jr.
Will I. Lewis Drilling Co.
Denver

We'd be glad to hear from other readers along this line.—Ed.

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"I suggest that when the government says you must employ more, produce more, find wider markets but still bear a 50% tax burden on your profits, it is not being consistent.

"Governments find it difficult to

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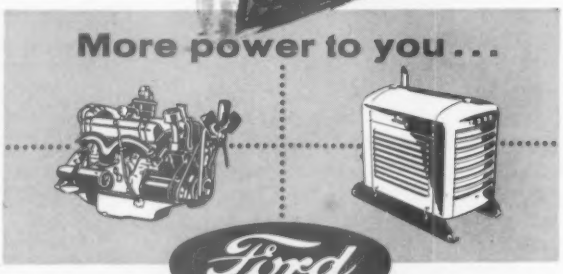

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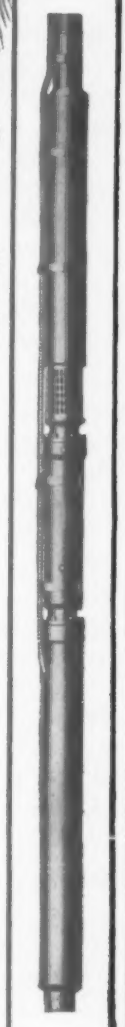

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move in harmony with the economy's needs whenever those needs lie in the direction of stripping for greater flexibility. If a government control isn't accomplishing what was hoped for, the usual answer is to extend its area by adding other controls. These can be built up until the pervading tone of an economy is one of inhibition rather than incentive."

Trervor F. Moore, vice president and director, Imperial Oil, in a speech to the Montreal Control, Controller's Institute of America.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

MAY

7-10	American Institute of Chemical Engineers meeting, Sheraton-Cleveland Hotel, Cleveland.
8-11	American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.
8-12	American Gas Association, distribution and production conference, Sheraton Hotel, Philadelphia.
9-11	Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles.
10-12	American Society of Mechanical Engineers, production engineering conference, Royal York Hotel, Toronto.
10-12	Canadian Institute of Mining and Metallurgy, oil and gas division, and Calgary and Edmonton petroleum engineering sections of Canadian Institute of Mining and Metallurgy and American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, McDonald Hotel, Edmonton, Alta.
11	Panhandle Producers and Royalty Owners Association, annual meeting, Herring Hotel, Amarillo, Tex.
11	Texas Petroleum Research Committee, thirteenth oil recovery conference, Memorial Student Center, Texas A & M College, College Station, Tex.
11-12	American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.
11-12	Texas A. & M. College, thirteenth oil recovery conference, College Station, Tex.
12	Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.
14-17	Texas Independent Producers and Royalty Owners Association, Scharbauer Hotel, Midland, Tex.
16-19	American Petroleum Institute, Division of Marketing, midyear meeting, Americana Hotel, Miami Beach.
17-19	Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Hotel Lassen, Wichita.
17-19	Society of Professional Well Log Analysts, second annual meeting and logging symposium, Sheraton-Dallas Hotel, Dallas.
19-21	Michigan Basin Geological Society,

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21-24 American Petroleum Institute, Division of Transportation, midyear highway conference, Bellevue Stratford Hotel, Philadelphia.

22-25 Design Engineering Show, Detroit, Mich.

24-25 Western Petroleum Refiners Association, computer conference, Ben Franklin Hotel, Philadelphia.

25 Pennsylvania Grade Crude Oil Association, Bradford District Pennsylvania Oil Producers Association, joint annual meeting, Pennhills Club, Bradford, Pa.

25-26 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual Rocky Mountain petroleum sections, joint meeting, Farmington, N. M.

25-26 American Gas Association, gas transmission conference, Brown Palace and Cosmopolitan Hotels, Denver.

28-June 2 Special Libraries Association, petroleum section meeting, San Francisco.

JUNE

1-2 Kentucky Oil and Gas Association, annual meeting, Phoenix Hotel, Lexington.

1-3 Interstate Oil Compact Commission midyear meeting, Shamrock-Hilton Hotel, Houston.

5-6 Petroleum Electric Power Association, meeting, Mayo Hotel, Tulsa.

6-8 Instrument Society of America, summer instrument-automation conference and exhibit, Royal York Hotel and Queen Elizabeth Hall, Toronto.

6-8 Sixth annual Appalachian underground corrosion short course, West Virginia University, School of Mines, Morgantown, W. Va.

9-17 European Congress of Chemical Engineering and Achema Congress, thirteenth exhibition and congress of chemical engineering, Frankfurt am Main, Germany.

11-15 American Society of Mechanical Engineers, summer annual meeting, Statler Hilton Hotel, Los Angeles.

11-16 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

12 Instrument Society of America and Air Pollution Control Association, air pollution instrumentation symposium, Hotel Commodore, New York City.

12-14 American Petroleum Institute, Division of Transportation, annual tanker conference, Oyster Harbors, Cape Cod, Mass.

12-16 Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.

13-16 Instrument Society of America, biennial international gas chromatography symposium, Kellogg Center, Michigan State University, East Lansing, Mich.

19-23 Harvard University, School of Public Health, air cleaning institute, Cambridge, Mass.

19-23 Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.

20-22 National Association of Corrosion Engineers, Greater Boston section, corrosion short course, Wentworth Institute, Boston.

20-24 Canadian Gas Association, annual meeting, Banff Springs, Alta.

22-24 American Association of Petroleum Landmen, annual meeting, Shamrock Hilton Hotel, Houston.

25-30 American Society for Testing Mate-

"Low maintenance cost sold us on Edward Mudwonder Valves,"

says Jess L. Warton,
Warton Drilling Co.,
Odessa, Texas

"Everybody knows that drilling contracting can be a tough business. And, those of us who make a living at it would be the first to say so. Yet, the difference between success and failure is often a very subtle matter.

"In my experience, making a go of it hinges largely on having plenty of know-how and experience in drilling, plus first-class rigs and other equipment, plus well-trained crews and tool pushers. Men and equipment have to be tops, and they must also work well together.

"For example, a successful drilling contractor has to be especially careful about selecting engines, pumps, valves, drill bits and other operating gear. The difference between best and next-to-best is the difference between a profit and no profit. Mud valves are a case in point.

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For additional information on Edward Mudwonder valves, see your favorite oil field supply store, or write Edward Valves, Inc., 1212 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company.

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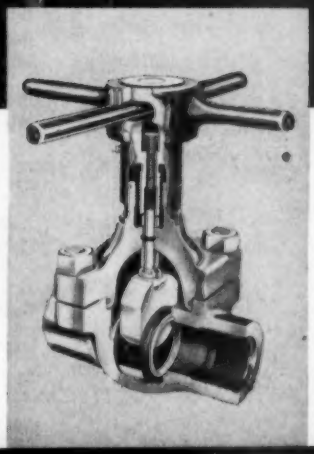
Jess L. Warton, Owner, Warton Drilling Company, shown at Rig #3 on lease near Andrews, Texas.



Mudwonder cut-away view shows the one-piece seat insert with Buna-N molded integrally over steel wear rings; chrome gate with "T" slot connection; separated stainless stem and double thread construction.

rials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

26-27 Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich.

26-July 7 Massachusetts Institute of Technology, summer program on dynamics and control of chemical engineering processes, Cambridge, Mass.

28-30 International Gas Conference, Stockholm, Sweden.

28-30 Instrument Society of America, joint automatic control conference, Boulder, Colo.

JULY

4-7 National Society of Professional Engineers, twenty-seventh annual meeting, Olympic Hotel, Seattle.

6-8 International Oil Scouts Association, annual meeting, Roosevelt Hotel, New Orleans.

10-21 University of Michigan, summer course on underground storage of natural gas, Ann Arbor, Mich.

26-28 American Petroleum Institute, Division of Production, eastern district meeting, The Greenbrier, White Sulphur Springs, W. Va.

AUGUST

2-4 Wyoming Geological Association, sixteenth annual field conference, Green River, Wind River, and Powder River basins.

28-30 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-Sept. 1 American Society of Mechanical Engineers, international heat transfer conference, Boulder, Colo.

SEPTEMBER

5-8 American Chemical Society, Chicago section, eleventh national chemical exposition, International Amphitheatre, Chicago.

7-9 Magic Plains Oil Exposition, Borger, Tex.

11-15 Instrument Society of America, fall instrument-automation conference and exhibit and sixteenth annual meeting, Biltmore Hotel and Memorial Sports Arena, Los Angeles.

12-13 American Gas Association, Southern Gas Association, annual accident prevention conference, Statler Hilton Hotel, Dallas.

13-15 Pacific Coast Gas Association, convention and annual meeting, Coronado Hotel, Coronado, Calif.

13-15 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

13-15 National Petroleum Association, annual meeting, Traymore Hotel, Atlantic City, N. J.

14 Natural Gasoline Association of America, Rocky Mountain regional meeting, Northern Hotel, Billings, Mont.

15-16 Kansas Geological Society, annual field conference, Mark Twain Hotel, Hannibal, Mo.

17-20 American Institute of Electrical Engineers, annual electrical conference of the petroleum industry, Jung Hotel, New Orleans.

18-19 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

20-21 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

24-27 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Muehlebach Hotel, Kansas City.

25-27 Texas Mid-Continent Oil and Gas Association, annual meeting, Texas Hotel, Fort Worth.

OCTOBER

1-4 American Gas Association, annual convention, Dallas.

4-6 American Association of Oilwell Drilling Contractors, annual meeting, Rice Hotel, Houston.

4-6 American Society of Mechanical Engineers, process-industries conference, Shamrock-Hilton Hotel, Houston.

8-11 Society of Petroleum Engineers of AIME, annual fall meeting, Memorial Auditorium, Dallas.

11-12 Western Petroleum Refiners Association, waste disposal and stream pollution conference, Hotel Lassen, Wichita.

15-17 National Association of Oil Equipment Jobbers, annual convention and trade show, Mayflower Hotel, Washington.

17-19 American Society of Mechanical Engineers, American Society of Lubricating Engineers, lubrication conference, Morrison Hotel, Chicago.

18-20 Rocky Mountain Oil and Gas Association, annual convention, Denver-Hilton Hotel, Denver.

18-21 American Association of Petroleum Geologists, Mid-Continent regional meeting, Amarillo, Tex.

25-26 Western Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

27 Natural Gasoline Association of America, southern regional meeting, Carlton Hotel, Tyler, Tex.

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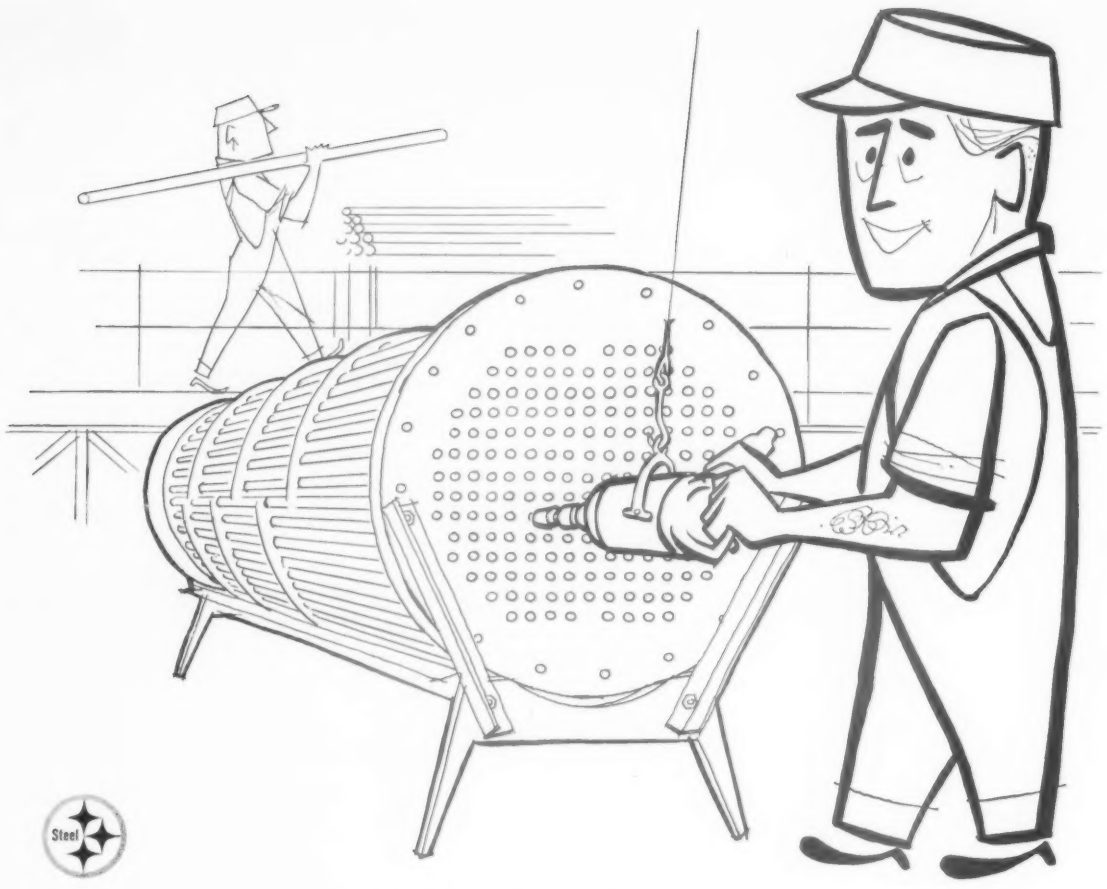

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the Journal said...

50 years ago

May 11, 1911

A joint unincorporated association to be known as Magnolia Petroleum Co. has been organized to take over refineries and other properties formerly owned and operated by John Sealy & Co. Headquarters are at Galveston. Plants and other offices are at Beaumont and Corsicana. The new organization plans to enter actively into the distribution and marketing of petroleum products.

Arkansas Natural Gas Co. completes laying of natural-gas line from the large Caddo field of northwestern Louisiana, to Little Rock, Ark. First natural-gas deliveries to Little Rock are expected to begin May 15. The new line also will serve Hot Springs and Pine Bluff, and various places along the route.

Oil men are taking solace in the fact that gasoline engines have just about put the windmills out of business for water pumping and other farm uses.

25 years ago

May 7, 1936

Shell Oil Co. and Standard Oil Co. of Indiana reveal plans for separate construction and expansion projects costing $47,500,000. Shell's projects include 304-mile 12-in. and 10-in. crude-oil pipeline, costing $4,500,000, from Bakersfield to company's Martinez refinery on San Francisco Bay. It is the biggest pipeline job in California in 25 years.

Richfield Oil Co. looms as major western integrated unit in projected reorganization after 5 years of receivership. Reorganization plan provides for amalgamation of Richfield, Pan American, and Rio Grande companies.

10 years ago

May 10, 1951

Long Beach Oil Development Co. launches 100-well drilling program from recently enlarged Pier A in Long Beach Harbor. New development project, one of largest undertaken in California in many years, augments 35-well drilling program already under way by Richfield Oil Corp. from the new pier.

Supreme Court decision in significant Champlin Pipe Line Co. case holds that oil pipelines operated as plant facilities and carrying only oil owned by them are not subject to federal regulation and cannot be forced to operate as a common carrier.

Carter Oil Co. initiates first organized water flood in Montana. New large secondary-recovery project involves former prolific Lander reservoir at Cut Bank, Glacier County, on the Blackfoot Indian reservation.

JOURNALLY SPEAKING

Wertz revisited

EDITORS are always sticking their necks out. You'd think they'd be satisfied to report just what's happened and let it go at that. But they have to get involved in why it happened and how, and then, pressing their luck still further, predict what's going to follow.

Sometimes we'd rather not be reminded of these prognostications when the target date rolls around. This accounts for the growing popularity of projecting to the year 2000 when we don't expect to have to face up to judgment, at least of the earthly type.

Then again, editors sometimes hit it right on the nose. And when somebody takes due note of the fact and invites the editor to go back for a second look, that's just frosting on the cake.

This happened the other day to Neil Williams, one of the Journal's veterans. Neil has been around the oil patch longer than some of you readers have been around any kind of patch. Twenty years ago, when clouds of world conflict were gathering, Neil took a look at a new field called Wertz Dome in Wyoming.

Wertz was no bonanza. It had a good water drive but a tight sand. The operator, Sinclair Oil & Gas Co., wanted to increase its production rate and improve recovery at the same time. So a well-engineered program of gas and water injection was begun in the unitized field.

All this looked fairly newfangled back in 1941, but Neil saw in this project a portent of things to come. So he stuck his neck out and wrote a comprehensive report on the whole deal, predicting that recovery would be improved, payout stepped up, and a nice return would accrue to Sinclair's progressive engineering.

Of course all this came true or we wouldn't be talking about it. And at Sinclair's specific request Neil went back last week to this scene of joint farsightedness. The result will be a "20-years after" story.

Thanks, Sinclair, for remembering.

Ave atque vale

THIS WEEK, something will be missing from the oil industry.

The many thousands of oil men who received and read Petroleum Week will receive it no more.

Petroleum Week will be missed—by the industry and by its competitors in the petroleum press. It would be the height of hypocrisy for any oil editor to say that this promising new publication was welcomed when it burst upon the scene nearly 6 years ago. But whether or not one welcomes competition, it must be admitted in all honesty that it is the vital spark of free enterprise.

Petroleum Week was good for us. It put every oil publication on its mettle. The Journal is the better for its having entered the field.

You the readers were, of course the ultimate beneficiaries. Your reading fare was served to you with g r e a t e r dispatch, with improved clarity, and with more depth by all of the fine publications which serve this progressive industry.

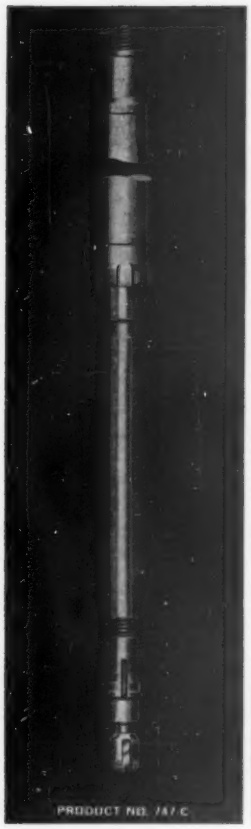
It does not follow that the disappearance of Petroleum Week will signal any letdown in the efforts of your petroleum press to serve you. The competitive spirit remains, and very strongly. All of us will continue to vie for your readership. We will compete with one another fairly and squarely as in the past, for your acceptance.

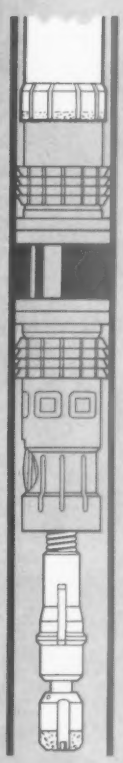
Speaking for the Journal, this sobering thought prevails. We renew our pledge, that if you will read the Journal each week, you will be informed of every development of significance affecting the petroleum industry today and tomorrow. This has always been our demanding aim. It will continue to be.

We editors work toward one goal and one only: to serve you as best we can. Only as we serve you do we at the same time provide the audience which our advertisers need to sell their products and services. The formula for success is mutual profit for reader, writer, and advertiser. But the priceless ingredient is you, the reader.

George Weber

Now Baker can mill over any retainer-type packer, bridge plug or cement retainer at a savings in time of...up to 75%





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The imports program should be reaffirmed and perfected

IT IS GOOD that the administration is laying open the whole subject of petroleum imports at public hearings this week.

A program of such importance should be reexamined periodically and its basic policy either affirmed or modified and its mechanics adjusted to fit changed conditions.

The danger is that the basic issues and objectives may become lost to sight in a mass of arguments and statistics and the crossfire of the many special interests.

WHAT SHOULD BE REAFFIRMED is that national security requires a domestic industry capable of continuing the development of our own natural resources; and that this can be achieved only by a certain restraint on imports of oil from sources vulnerable to enemy interruption.

This should not be nearly as difficult to justify as it was a few years ago. Most of the large importers appear willing to accept the principle.

As to volume of imports, it appears to the Journal that the present level may be slightly on the high side but is not far from a reasonable compromise of our national obligations both foreign and domestic. But, as we have said before, the total volume at any particular date is less important than having a firm policy and a workable program.

For a number of technical reasons there is much merit in relating the controlled imports to the demand for crude rather than products. Also for placing under the crude quota all refined and semirefined products and gas liquids—except for residual fuel which should have entirely separate treatment. This would make the program more practical and predictable.

The principle of continental defense supports treating overland imports from Canada and Mexico as domestic supplies when computing quotas for tanker-borne imports. But it could be accompanied by an informal warning to our contiguous neighbors not to increase shipments too much too soon.

Then many details need perfecting in the light of experience. The program should be "cleaned up" to simplify administrative and statistical control, to make it more certain and predictable, and to reduce the number of special situations and incongruities which have potentials for complicating if not undermining the program.

MUCH WILL BE ACHIEVED by the reopening if these objectives are affirmed and these perfections adopted so that all concerned can lay long-range plans with more certainty.

Once the major aspects of import control are firmly established, the remaining lesser problems and troublesome special angles, plus new ones which may arise in the future, will be much less formidable than they may appear when raised at the hearings.

this Dowell tool has revolutionized well completion, stimulation and workover practices

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Second, Abrasijet has been successful in perforating wells that could not be perforated using explosives. Several thicknesses of pipe and cement can be penetrated simply by adjusting the jetting time.

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Profits Rundown for First Quarter

	Gross Income		Net Income		Refinery Runs (b/d)		Liquid Production (b/d)	
	1961	% Change	1961	% Change	1961	% Change	1961	% Change
Jersey Standard	$2,286,000,000	3.3	$193,000,000	13.5	3,208,000	10.9	2,787,000	9.0
Texaco	803,467,000	9.5	108,141,171	11.1	1,380,511	7.0	1,297,922	8.5
Gulf			95,315,000	16.5	764,000	−1.9	1,498,000	4.5
Calif. Standard	459,144,000	1.9	65,973,000	8.6	521,115	6.5	463,300	11.3
Socony			59,800,000	27.0		7.0		6.0
Ind. Standard	530,953,000	3.1	43,820,000	38.3	681,000	10.6	344,000	8.5
Shell	467,735,000	2.2	34,709,000	0.5	492,100		332,000	−1.5
Phillips	304,128,000	0.9	27,506,000	6.6	234,100	−3.6	288,000	1.1
Sinclair	330,764,000	−1.1	16,096,000	30.8	423,443	0.6	200,524	12.3
Continental	200,093,000	−0.1	16,037,000	5.0	188,707	−2.6	200,218	−1.9
Atlantic	158,796,000	2.9	14,870,000	70.4	199,800	2.9	161,100	6.6
Cities Service	266,726,000		14,752,000	13.7				
Sun	195,804,000	7.1	12,011,000	36.6	227,011		160,344	
Tidewater	181,657,000		10,979,000		252,000		124,000	
Ohio Oil	91,221,000	−0.9	10,493,000	2.1	99,144	−1.6	119,677	10.1
Sunray Mid-Cont.	118,585,612	5.5	10,173,728	18.6	153,000	3.4	91,000	−1.1
Union Oil	128,558,135	4.3	9,164,026	65.7	157,322	3.4	123,300	28.7
Pure			6,702,000					
Ohio Standard	100,136,000	7.6	5,518,000	8.9	141,562	−1.7	32,007	4.6
Richfield	73,721,000	7.2	5,422,536	−22.4	159,467	9.0	79,766	3.7
Signal Oil & Gas	81,634,000		4,100,000	20.6	64,588		57,455	
Colorado Oil & Gas	11,937,069	8.6	1,136,464				10,341	51.9

First Quarter Raises Hopes for Year

• Several integrated companies show best first quarter profits ever. Others have sharp increases. But big test of the year will be the gasoline season.

INTEGRATED oil companies came out of the first quarter covered with the sweet smell of profits.

Many companies showed sharp increases in earnings over the same period in 1960, and several did the best business for a first quarter in their histories.

The first-quarter performances now have kindled hopes that 1961 will be a highly profitable year for the industry. Some executives, however, temper their enthusiasm with warnings that the second quarter will be the critical period.

Much depends on how good a start the industry makes on the gasoline season. If demand holds brisk and prices keep firm, companies count on a good year. If the opposite is true, profits will erode through the second and third quarters.

What happened . . . In retrospect, most executives give this rundown of the first quarter:

January and February were excellent months for their business. Demand for heating oils and gasoline remained high through the middle of February. Prices also held at good levels.

Business started fading in late February and the trend continued through March as the weather warmed and oversupply of products became an ominous problem.

Production of petroleum liquids and refinery runs had been kept near or above 1960 levels during most of the first quarter, but cutbacks started late in March and have continued through April. The industry has made big strides toward restoring a good supply-demand balance, and the profits outlook hinges on this achievement.

Socony Mobil President Albert L. Nickerson explained the situation to his stockholders like this: "Due to the high level of operations during the first 2 months of the year to meet heating-oil demand, industry gasoline inventories reached excessive levels and prices subsequently weakened. Unless the oil industry's refinery runs come into better balance with demand, our earnings for the balance of 1961 will be adversely affected."

Board Chairman Rawleigh Warner of Pure Oil also commented on the current price issue: "Many oil companies, with the short-sighted notion of reducing unit costs by increasing their refinery throughput, have impaired their own corporate health by selling the excess product at cut-rate prices. Today's weak price structure is a direct result of excess refinery production and excess product inventories."

Some records . . . The improvement

in oil company profits generally outgained the nation's economy as a whole.

A survey of corporate earnings by The Wall Street Journal showed that only aircraft builders, movie makers, business equipment companies, and oil companies recorded profits gains of 10% or more in the first quarter.

Some of the oil-company gains were spectacular. Atlantic Refining increased earnings by 70.4% over the first quarter 1960. Its profits went from $8.7 million to $14.8 million this year.

Union Oil marked up a 65.7% gain—from $5.5 million to $9.1 million. Sun improved profits 36.6%—from $8.7 to $12 million. Socony Mobil's earnings were 27% greater this year than last for the period, Indiana Standard 38%, Signal Oil & Gas 20.6%.

Texaco announced its first-quarter net of $108.1 million was the largest for the period in its history. It represented an 11.1% gain over last year's first quarter. Gulf's net of $95.3 million was its greatest from operational income.

Jersey Standard maintained its position as the industry's top earner with a net of $193 million for the quarter, representing a 13.5% gain.

Other substantial gainers included California Standard, Phillips, Continental, Cities Service, Sunray Mid-Continent, and Ohio Standard.

Operations up . . . Company explanations for the good showing followed a common pattern.

Gulf said its increased earnings came solely from domestic operations, specifically increased crude production, greater gas sales, more realistic price realization, and increased efficiency.

Texaco's high earnings in January and February contributed to its spectacular showing despite a slump in March.

California Standard increased its income from the Eastern Hemisphere to offset adverse effects of serious price wars on the West Coast. The company also showed gains in production of crude and natural-gas liquids and sales of natural gas.

Union Oil Chairman Reese H. Taylor said plainly: "Union's sales and earnings are up because we are obtaining more income from more activities and at the same time lowering operating expenses. Another contributor to profits of increasing importance is the Collier Carbon & Chemical Corp., a major subsidiary, whose sales have risen 33% in the past 2 years."

Socony Mobil's increased earnings stemmed from "higher volumes and greater efficiency in world-wide operations." Continental listed major factors for its better showing as improved refined product prices and lower intangible development costs.

Phillips also experienced price improvements for refined products, ammonia and other fertilizers, synthetic rubber, and Marlex plastics.

Jersey Standard registered higher operating levels, particularly abroad, as well as improved realizations for motor fuels, distillates, and natural gas in the United States. Its product sales volumes showed a 3% gain for the quarter.

The outlook . . . Company executives tend to be optimistic about prospects for the rest of the year despite the known hazards.

Texaco's Long said he expects the good first-quarter trend to continue in 1961, especially in the third and fourth quarters. He figures domestic petroleum demand should increase by 2% or 3% this year. He also looks for a 7% total increase in other free-world nations. This would be an average free-world increase of 5%.

By 1965 Long expects petroleum consumption in the free world to be a third greater than it is today.

Gulf officials also reported their estimates indicate a continuing growth in free-world demand at the rate of 5 to 6% for the next several years. Such an increase will mean the non-Communistic nations will be consuming about a million barrels daily more this year than last.

Continued growth of this size, Gulf estimates, should put supply and demand in better balance within a relatively short time and should reduce the surplus that has plagued the oil industry for the past several years.

Sun Oil President Robert G. Dunlop observed that "it is not unreasonable to expect that demand for petroleum will be half again as great in another 15 years as it is today."

Pure Oil Chairman Warner said he expected his company's sales this year to continue improving along with the general pickup in business. And Sunray Mid-Continent President Paul E. Taliaferro estimates that if industry conditions remain at present levels 1961 profits will show improvement over 1960.

Taliaferro also had a word about the future stability of the industry. "It continues to be my belief that the oil industry, while it faces a number of difficult problems, is one that is essential to the growth and security of our nation and therefore will continue to thrive."

Citronelle Water Flood Approved

A WATER-FLOOD program that is expected to produce an additional 77 million barrels of oil from the Citronelle field has been approved by the Alabama Oil and Gas Board.

Witnesses at a Mobile hearing on the proposal said the field contains an estimated 499 million barrels of oil in place.

The water-injection program will cover 138 wells already completed in the original unit, plus one more which is scheduled to be drilled.

The Mobile County field's total production exceeds 21,178,000 bbl. Of this amount, 16,268,980 bbl. have been produced by the 138 wells in the original unit.

William L. Horner, an engineer who has been making a study of the water-flood plan for G. H. Jett, Shreveport operator, told the hearing the additional oil to be recovered would be worth at least $231 million.

He said water flooding would boost ultimate recovery from about 14.8% of the estimated oil in place to 30.34%.

No opposition to the recovery program was expressed at the hearing.

A pilot water-flooding operation is expected to be underway by June 1. Work on the entire project will be pushed while results of the pilot plant are being analyzed.

Humble Goes ENCO in West But Keeps Esso

• Several million dollars will be spent this year to advertise the new brand name for some 10,000 stations in western and midwestern states.

HUMBLE went "ENCO" last week in 20 marketing states but left untouched, at least for now, its valuable Esso brand name in the East.

The switch to ENCO surprised no one—the industry had the story pegged for months. But telling the general public is another matter.

It will cost Humble Oil & Refining Co. several million dollars this year just to advertise the new brand name.

Specifically, here is what Humble is doing:

In 20 western and midwestern states, some 10,000 service stations now using a dozen brand names will market ENCO gasoline. Premium grade will be ENCO Extra.

Where super premium is sold, as in Texas, it will be called ENCO Golden. The old brands, such as Humble, Carter, Oklahoma, and Pate, will disappear.

However, the name Humble will continue to appear on the facades of all stations of the company.

In Texas the name Humble will actually continue to be used to identify the station itself.

This means that the word Humble will appear in the identifying oval in Texas stations, while the word ENCO will appear in the oval of stations in the other 19 western states where Humble markets.

NEW LOOK for Humble stations in the west will push ENCO brand. The tie-in with the familiar "Happy Motoring" slogan will be continued.

Status quo in East . . . Meanwhile, in Humble's eastern territory, from New York to Louisiana, the 20,000 stations which sell Esso-brand products will continue without change.

D. W. Ramsey, Jr., vice president for marketing, conceded in Houston last week that there are "emotional" problems connected with the Esso brand name—the best-known and largest-selling brand in its territory.

Ramsey also left open the question of whether Humble will actually extend its marketing territory to cover every state.

While top officers of the parent Standard Oil Co. (N. J.) have said they want the new Humble to market nationally under a single brand name, the Humble company last week said nothing about such sweeping plans.

Ramsey said there is no target date for Humble to move into all 50 states. (It's now in 40.) He added: "We will have to justify all our marketing operations. We won't go into all states just for the sake of being there."

Ramsey did point out that the company has started marketing in several new states since Jersey Standard's domestic operations were merged into the new Humble in the fall of 1959.

Why ENCO was chosen . . . In selecting the ENCO name, Humble reasoned this way:

It could not use Esso in states where other Standard companies of the old Standard Oil Co. are operating.

It preferred a shorter name than Humble to give better visibility. It wanted a four-letter name that was easily pronounceable.

The letters ENCO fitted these requirements. ENCO consists of the first two letters of "energy" and "company."

Changeover . . . The actual changeover to ENCO will vary by region.

The change for Carter stations took place last week and for most others will take place this week. Most of the stations in California already are ENCO.

Teaser ads in newspapers and elsewhere have been run to acquaint the public with the impending announcement by Humble. Advertising will feature a huge red fist denoting power in the new gasoline.

The company will retain "Happy," the oil drop cartoon character, and the slogan "Happy Motoring," which have been used in the past for all its brands.

States in which ENCO products will be marketed are Arizona, California, Colorado, Idaho, Illinois, Indiana, Iowa, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, Wisconsin, and Wyoming.

Industry Takes a New Look at Imports

ISSUE of crude imports is boiling again. Participants in the continuing controversy pressed their views at Interior's hearing in Los Angeles and made ready for Washington hearings this week.

- IPAA PLANS to push for a 150,000-bbl. reduction in imports and would base the level of imports on crude demand.
- ON THE WEST Coast, Tidewater urged that a higher level of imports be permitted.
- A CASE for historical importers was made on the East Coast by Atlantic.
- PRINCIPAL FACTOR in the controversy—How imports compare with crude and product demand and crude production—is detailed on p. 62.

IPAA Urges Changes to End Imports "Leakage"

IPAA plans to seek a basic change in the imports-control program which could bring about a substantial cut in total oil imports.

The move will be made when the program comes up for review by the Secretary of the Interior at hearings in Washington this week.

If put into effect, the Independent Petroleum Association of America plan would reduce total imports (except for residual fuel oil, which is on a separate basis) by something like 150,000 bbl. daily.

However, IPAA considers it even more vital to change the imports formula in other ways. The aim: To eliminate what it terms leakages, and to put the control program on a basis more favorable to restoration of a healthy domestic producing industry.

Principally, IPAA favors:

. . . Basing allowable imports into District 1-4 (east of the Rockies) on demand for crude oil. The import quota is now based on total demand for refined products and is held to 9% of the 1954 ratio.

If the new basis is adopted, IPAA will request that imports be 10% of crude demand. The 1954 ratio was 10.7%. The difference would bring about the 150,000-bbl.-daily reduction.

. . . Deducting exempt overland imports from Canada and Mexico from the total of controlled imports. This would be tantamount to considering Canadian shipments as part of domestic supply, as is done in District 5 (West Coast).

Thus, as Canadian imports increase, it would be the importers of offshore oil who would have to make room, rather than domestic producers.

Shaping the proposals . . . This program was hammered out at a 4-hour working session of the IPAA's import policy committee in New Orleans last week. Association officials were also advised about positions to be taken on other aspects of the program that may be raised at the hearing.

The need for a substantial cut in imports will be stressed by IPAA witnesses. They will be armed with statistics showing that U. S. crude production has fallen below the 1956 level and that the domestic industry is not in a healthy condition.

The shift in the basis of setting the import total is considered vital because product demand is growing faster than crude demand.

The IPAA plan would put all refined products except resid in with the crude quotas.

This is already done in the case of most refined products. But there is a fear that various exemptions may be enlarged in the future to permit skirting of the program's objectives. Examples are military imports of jet fuel, refined products from Puerto Rico, and natural-gas liquids from Canada.

The proposed new treatment of Canadian imports is justified as embracing the concept of continental defense.

All imports of Canadian crude, refined products, and gas liquids would be deducted from the overall permissible imports from other countries. In other words, Canadian imports would remain free of restrictions and be treated as domestic supply. This is already being done in District 5.

However, IPAA stands ready to warn Canada that this treatment may be withdrawn if shipments increase too rapidly—particularly if Canada continues to supply all her eastern markets with imported crude while increasing exports to the U. S.

Similar treatment would be afforded legitimate overland imports from Mexico, but IPAA takes a strong stand against the present "circumvention" by which crude is tankered to Brownsville in bond, exported by truck, and brought back across the border in the same trucks as exempt imports.

Other phases . . . On other aspects of the imports program, the IPAA policy committee took these stands:

. . . Residual fuel oil. No position was stated, because the resid program has just been revised and may

be separately reviewed again later. But IPAA wants both demand for and imports of resid excluded from all calculations relating to other imports.

. . . Asphaltic crudes. IPAA is opposed to any special exemption.

. . . Military imports. No exemption is considered justifiable, as demands can be supplied by U. S. refineries.

. . . Puerto Rico. The IPAA would prevent any increase in the exemption for refined products.

. . . District 5. Endorsement is given to the present program for the West Coast.

. . . Unfinished oils. The IPAA would prohibit importation even when (as at present) deductions are made from the importer's crude quota.

. . . Refined products. The IPAA would keep these (except for resid) under the crude quotas, but urge that some means be devised to limit them to products not available from U. S. refiners and to prevent the exemption from becoming a loophole.

. . . Refinery quotas. Endorsement is given to allocation of import quotas to refiners.

. . . Historic quotas. The IPAA urges elimination of historic allocations and the basing of all quotas on refinery throughput. This was the most hotly debated subject at the committee session, and the stand was adopted by a close vote.

Some felt that producers should be concerned only with the level of total imports and should not intervene in an argument among refiners as to division of the total.

Getty Says:

West Coast Needs More Imports

DEMAND for oil on the West Coast is growing, but the local supply is shrinking and this trend is expected to continue.

George F. Getty II, president of Tidewater Oil Co., made this analysis of the oil situation in District 5 last week on the eve of the import hearing in Los Angeles.

Much of what Getty said was repeated in various forms at the 1-day hearing.

Getty says almost half the oil needed to meet the growing West Coast demand will come from sources outside the district if the downward trend in production continues.

He says the present oil deficit in the district is 30% or 387,000 bbl. daily.

If demand grows at the annual average rate of 2.3% during the 60s, Getty sees this pattern for the oil deficit in the seven-state area:

. . . By 1965 the deficit will reach 540,000 bbl. daily if production stays at the 1960 level of 910,600 bbl. daily. This deficit will grow to 600,000 bbl. daily if production follows the present downward trend and drops to 850,000 bbl. daily. These figures are based on an estimated demand of 1,450,000 bbl. daily.

. . . By 1970 the deficit will reach 705,000 bbl. daily if production holds at 910,000 bbl. daily. Based on a 1970 fall to 790,000 bbl., the deficit will jump to 825,000 bbl. These estimates are based on a consumption of 1,615,000 bbl.

Outside supply . . . Getty points out the West Coast's growing appetite for oil will continue even though big volumes of gas and imported oil are moving into the district.

Natural gas moving into the district has helped depress the oil shortage. Getty estimates the 1960 deficit would have reached a whopping 900,000 bbl. daily had it not been for the 1 billion cubic feet of gas moving into the state daily.

The flow of oil from other states has grown tenfold between 1950 and 1960, hitting 159,000 bbl. daily last year.

Foreign oil started moving into the coast in volume in 1952 when 31,000 bbl. daily was imported. Foreign imports have swelled to 319,000 bbl. daily, but there is still a need for more imported oil, he says.

Need more oil . . . Getty says there is nothing in the cards to indicate either that demand will fall off or that production will pick up.

With this situation facing the district, he urges an increase in import quotas and the inclusion of Canadian crude as part of the district's supply and demand figures. He set no figure for a new imports total, but said it should be high enough to balance supply and demand.

Disruption Seen if Historical Imports Killed

ATLANTIC Refining Co. presents the case for the historical importer in a paper recently completed after a 4-month study of the impact of import controls on Districts 1-4.

Because the question of quotas for historical importers vs. quotas for inland refiners will be one of the key issues at the imports hearing in Washington this week, it is likely that Atlantic will use material from the report in its presentation.

In the report, Atlantic puts a great deal of emphasis on the disruptive effects it feels would occur if the present "floor" on quotas for historic importers were removed and quotas were based solely on refinery throughput.

Atlantic feels that this would not help national defense and that it would do considerable harm to many oil companies and would cost consumers more.

Disruption . . . Atlantic contends that in any control program the Government should try to keep to a minimum any disruption of the flow of raw material in the economy.

No national-security advantage is gained by unnecessary disruption, the company points out.

"The proper objective of allocation policy should be to approximate as closely as possible the objective of the competitive process—the most economic disposition of

How U. S. Imports Compare to Demand and Crude Production

(Thousand Bbl. daily, except ratios)

Basic data for checking import ratios in Districts 1-4

	1956	1957	1958	1st Half 1959	2nd Half 1959	1st Half 1960	2nd Half 1960
Total Refined Prod. Demand	8,010	8,220	8,229	8,687	8,304	8,833	8,476
Total Crude Oil Demand	6,953	6,989	6,666	7,055	6,854	6,996	6,974
Crude Oil Production	6,193	6,239	5,850	6,346	6,072	6,237	6,171

Record of imports (controlled and non-controlled)

Controlled by 9% Limitation	744	765	905	892	741	787	755
Non-controlled from Canada	50	56	58	57	56	66	61
From Puerto Rico (Excluding Resid)	3	4	18	20	32	21	28
Total (Ex Resid)	797	825	981	969	829	874	844
Total Residual Fuel*	451	484	513	723	529	726	556
Total Imports	1,248	1,309	1,494	1,692	1,358	1,600	1,400

Comparisons of imports with demand and crude production in Districts 1-4

	Expressed as per cent						
Ratios to Product Demand							
Imports Limited to 9%	9.3	9.3	11.0	10.3	8.9	8.9	8.9
Total Imports (Ex Resid)	10.0	10.0	11.9	11.2	10.0	9.9	10.0
Total Imports	15.6	15.9	18.2	19.5	16.4	18.1	16.5
Ratios to Crude Oil Demand							
Imports Limited to 9%	10.7	10.9	13.6	12.6	10.8	11.2	10.8
Total Imports (Ex Resid)	11.5	11.8	14.7	13.7	13.7	12.5	12.1
Total Imports	17.9	18.7	22.4	24.0	19.8	22.9	20.1
Ratio to Production							
Imports Limited to 9%	12.0	12.3	15.5	14.1	12.2	12.6	12.2
Total Imports (Ex Resid)	12.9	13.2	16.8	15.3	13.7	14.0	13.7
Total Imports	20.2	21.0	25.5	26.7	22.4	25.7	22.7

Records for District 5

Crude Oil Production	958	931	860	849	844	833	830
Total Imports	194	272	216	222	290	289	350
Ratio Imports to Production	20.3%	29.2%	25.1%	26.1%	34.4%	34.7%	42.2%

Records for total U. S.

Total Demand	9,209	9,386	9,358	9,832	9,495	10,051	9,709
Crude Oil Production	7,151	7,170	6,710	7,195	6,916	7,070	7,001
Imports:							
Crude Oil	934	1,023	953	960	971	1,015	1,015
Products (Ex Resid)	52	68	241	231	148	142	147
Residual Fuel Oil*	456	490	516	723	529	732	588
Total	1,442	1,581	1,710	1,914	1,648	1,880	1,750

Import ratios for total U. S. expressed as per cent

Ratios to Demand							
Crude Imports	10.1	10.9	10.2	9.8	10.2	10.1	10.5
Total Imports	15.7	16.8	18.3	19.5	17.4	18.8	18.0
Ratios to Crude Production							
Crude Imports	13.1	14.3	14.2	13.3	14.0	14.4	14.5
Total Imports	20.2	22.1	25.5	26.6	23.8	26.7	25.0

*Includes some distillate fuel for bunker use. Source: U. S. Bureau of Mines and Oil Imports Administration.

resources," Atlantic says in its report.

In a competitive system East Coast refiners obviously would be the ones using imports, Atlantic argues. Therefore, a control plan should try to preserve that pattern as much as possible since it obviously is the more economic.

Inland quotas . . . As for the argument that inland refiners need protection the same as domestic producers, Atlantic contends that the very existence of controls helps give them protection.

Without controls, the company says, East Coast refiners using imported crude inevitably would press westward with products and thereby increase competition with inland refiners in those areas.

"Since the influx of foreign crude oil has been effectively curtailed, it is redundant to maintain that inland refiners merit further subsidy through increased participation in crude-oil imports," Atlantic says.

Competition . . . Atlantic also maintains that historical allocation minimizes disruption of competition patterns.

"The varying effects of shifting to refinery inputs as the allocation basis would splinter the Atlantic Coast refiners with substantial imports into arbitrary groups.

"Three companies—Atlantic, Gulf, and Standard of California—would suffer most because each would lose approximately half of its present allocation.

"In sharp contrast, three companies—Cities Service, Standard Oil Co. (N. J.), and Texaco Inc.—would get allocation increases of more than 20%.

Such irregular allocation changes would significantly affect the relative raw-material costs of the Atlantic Coast refiners, Atlantic contends, and would have a big impact on the competitive position of each company involved.

"Refiners with most of their District 1-4 capacity on the Atlantic Coast would suffer much more severely than Atlantic Coast refiners which also have substantial capacity elsewhere," Atlantic says.

Finally, the company argues, a switch to a refinery-input basis for quotas would mean higher prices to East Coast consumers.

In 1960, Atlantic claims, the import program caused a transfer of more than $100 million from the East Coast market to inland areas because of the "enforced" crude swaps with inland refiners.

This cost would rise even higher if a larger share of imports were allocated on a refinery-input basis, Atlantic points out.

In the long run the consumer pays for such increased costs, Atlantic concludes.

Texas Eastern Adds Storage

TEXAS Eastern Transmission Corp. is adding 500,000 bbl. of underground LPG storage facilities at its Mont Belvieu, Tex., terminal, and another 400,000 bbl. at its Todhunter, Ohio, terminal.

The projects are at the two ends of the Little Big Inch pipeline. They will make possible the shipment of greater volumes of propane, normal butane, and isobutane.

Capacity at the Todhunter terminal will be raised to more than 1,400,000 bbl. The terminal has the largest mined underground storage in the world.

The new cavern is being mined from shale at 450 ft. and will be ready to store propane by the end of the year.

The cavity at Mont Belvieu is being drilled into the Barbara Hill salt dome at 2,000 ft. below the surface. Isobutane will be stored after leaching-out is completed.

The two projects will cost $3 million.

watching WASHINGTON

Clyde La Motte

- **It is high time to get moving on gas regulation . . .**

THERE HAS never been a more opportune time than right now for strong advocacy of a sensible plan for natural-gas regulation.

There has never been a time when the need was greater. The utility-type cost-of-service approach has proved unworkable. The move to area pricing has bogged down badly. President Kennedy's proposals, including exemption of small producers, offer little real hope.

Add to that the fact that the Federal Power Commission is in a suspended state, facing a new majority that could reverse anything the present commission does.

In this uncertainty, the FPC staff has no guidelines, no targets.

- **Area-pricing approach: No profile of courage . . .**

THERE APPEARED to be some glimmer of hope last fall when the FPC, in the Phillips case decision, announced its intention to use the area-pricing method.

It would, the FPC said, scrap the cost approach and would price gas as a commodity. This made sense.

It also appeared plausible that if prices were set for a broad area, cases of companies within that area could be disposed of much more quickly than on an individual case-by-case approach.

Perhaps most important of all, the move made it appear that at last the FPC was in motion and its fumbling indecisiveness was a thing of the past.

Unfortunately, this is not how it has turned out. Having taken one bold step, the commission became hesitant again. For instance, it did not say: Here is the type of data we need, and this is how and in what form we want it presented. It did not draw clear-cut lines at all.

Instead, it opened the door for all and sundry to come in to propose and oppose. The nit-picking sessions at Midland and Washington resulted—with confusion the chief product.

In its handling of the area-pricing approach, the FPC has been about as effective as an umpire would be if he were to call in the opposing players, manager, and coaches to help him rule on a close play at the plate.

- **Industry itself hasn't been much help, either . . .**

THE INDUSTRY is not in much of a position to throw rocks at the FPC. Its own record in this regulatory mess has not been one glowing with constructive suggestions or cooperation.

The industry has been bogged down, divided. Some segments have been too adamant, unwilling to yield an inch. Inertia seems to have overcome others. And some seem to be under the delusion that if the mess is left alone, the Government will finally throw up its hands in despair and get out of the regulatory business entirely.

Fortunately, there are industry leaders who are convinced that the industry has a responsibility to itself and to the public to help get this problem solved.

Almost every knowing person agrees that unless something is done, the consuming public will be the big loser in the long run. And if this happens, whom do you think will be blamed?

Letter Has Udall Treading Hot Water

• Interior Secretary's foes exult over reports that he asked friend to write Washington oil men for donations to Democratic fund dinner. And his denial that he okayed "soliciting" isn't expected to wash out all tar spots.

INTERIOR SECRETARY Stewart L. Udall seems destined to be the most controversial member of President Kennedy's cabinet.

He has been in and out of hot water several times already, principally because of statements on non-Interior matters such as the Cuban situation.

His political enemies got some fresh ammunition when newspapers published a story that Udall had asked an oil man to solicit other oil representatives in Washington to buy tickets for a $100-a-plate Democratic Party fund-raising dinner.

The story was based on a letter written by J. K. Evans, Washington representative for Asiatic Petroleum Co., to 56 other oil representatives in Washington.

In the letter, dated April 5, Evans said Udall had asked him to solicit the oil and gas industry in Washington.

Evans referred to Udall as "a friend of long standing" and said the secretary had told him he had a "very sizable quota" of tickets to dispose of for a May 27 dinner honoring President Kennedy.

Last week a Washington newspaper learned of the letter and banner-lined a story on Page 1.

Udall quickly called a press conference. He flatly denied authorizing Evans to solicit the oil industry, although he frankly admitted that he had talked to Evans about the dinner.

He said he had not known of Evans' letter until after it had been mailed and that when he did see a copy he was "appalled" and "flabbergasted." He did not explain why he waited almost a month before denying that he had asked Evans to approach oil representatives.

Udall made no bones about trying to sell tickets to the dinner. He said this was a traditional way to raise party funds.

However, Udall made it clear he felt Evans had used the wrong approach in trying to sell tickets. Proof of this, he said wryly, was that Evans had not sold a ticket as a result of the letter writing.

Secretary Udall
"... appalled, flabbergasted ..."

Rundown . . . Udall gave this history of events behind the incident:

He said that he and Evans had been friends since he (Udall) first went to Washington as a congressman. He said he had sat at the same table with Evans, a Democrat, at several Jefferson-Jackson Day dinners. Therefore it seemed natural that he would mention to Evans the upcoming dinner, he said.

However, Udall insisted he simply had in mind that Evans would get a "few" of his friends to attend. He said he had no inkling that Evans would make a broad-scale effort.

When he heard of the letter, he said, he telephoned Evans and got the impression that Evans was going to try to recall the letters or get them destroyed.

The day after Udall's press conference, Evans issued a statement defending his actions.

He said he had been a Democrat ever since casting his first vote and that in helping in the fund-raising

Here's What Kicked Up the Fuss

THIS is the text of a letter by J. K. Evans, Washington oil-company representative, asking other Washington representatives to buy tickets to a Democratic Party dinner.

Dear friend:

Secretary Udall, who happens to be a friend of long standing, has asked me as a personal favor to him to solicit the oil and gas industry in Washington in an effort to help the secretary dispose of his "very sizable quota of tickets for the Jefferson-Jackson Day dinner."

The dinner will be held on President Kennedy's birthday on May 27. Tickets are $100 a plate or $1,000 for a table of 10. It is being held at the National Guard armory in Washington, D. C.

The procedure that the secretary has asked me to follow is to have all checks made payable to the Democratic National Committee, and if for some personal reason you do not wish to follow this suggestion, please contact me.

Send your check to me together with a note indicating to whom and where you wish the tickets mailed.

Thanks for your cooperation.

Sincerely,
Jack Evans

(At the bottom of the letter was a secretarial note that a carbon copy of the form letter was being sent to Udall.)

dinner "I acted as a private citizen to support a cause in which I believe."

He said he was not issuing the statement "through any feeling of guilt or to recapture anyone's favor."

Recipients worried . . . The letter had caused concern, long before the story broke, on the part of many who received it.

They feared that its wording, together with the fact that each letter contained a list of all those being solicited, would make it appear that an oil representative was trying to "line up" the industry behind Udall and the administration.

This, they felt, was in poor taste, particularly since Udall's department handles many oil and gas matters.

Most of all, they feared that the letter would fall into hands of newsmen, and that some might "slant" their stories to make it appear the oil industry was trying to influence or curry favor with Udall.

Also, some predicted the Evans letter would be put in the same category as a letter written in 1956 by H. J. Porter, a Houston oil man, urging oil company officials to support a Republican fund-raising dinner in Houston.

At that time, a strong effort was being made to pass a gas bill, and Porter's letter was used as an instrument to help kill the legislation.

In the current situation, however, it appears that most public reaction over the ticket selling will be directed at Udall rather than at Evans or the industry.

For, as one of the Washington newspapers pointed out, it would be ridiculous to blame the Washington oil representatives simply because they received a letter asking them to buy tickets to a dinner.

Prospects Dark for Texas Small-Tract Bill

IT LOOKS as if a bill that would subsidize tiny-tract drilling in Texas has little chance of getting through the state legislature this year.

The controversial Boysen bill was still tangled up in committee action in the Texas House last week.

Two successive subcommittees of the Oil, Gas, and Mining Committee have been unable to agree on reporting out the bill.

Rep. Vernon Steward, committee chairman, has been quoted as saying the bill has virtually no prospects even if reported out of committee. His reasoning: The House probably wouldn't have time to consider it in the remaining days of the session.

The bill says proration of gas wells must be based at least one-third on the well. It would counteract the effects of a landmark decision by the Texas Supreme Court which struck down a proration order of this kind issued by the Texas Railroad Commission in the Normanna case (OGJ, Mar. 13, p. 100).

The Normanna formula was the standard rate adopted by the commission for gas fields containing small-tract wells.

Critics charge that it permitted wholesale drainage of gas reserves from adjoining leases and contributed to the state's over-drilling problem.

Defenders argue that it safeguarded the rights of the small operator.

Both sides move . . . Foes and proponents of the Boysen bill have made new moves to strengthen their positions.

The Texas Land Owners and Independent Oil and Gas Producers Association, formed to push the bill, has hired an experienced lobbyist to direct its campaign. He is Miller Walker, former state representative from Jefferson County.

The association also has opened permanent headquarters in Austin.

Meanwhile, a rival organization of prominent independents has been established. It is called the "Independent Oil and Gas Producers Committee Against House Bill 1025."

A statement released by Fred Shield of San Antonio, Charles W. Alcorn of Houston, and Charles E. Thompson of McAllen says the committee will present a case against this bill and any other that tries to limit the authority of the Texas Railroad Commission.

Commission gets first case . . . While the legislative scuffle continued, the Railroad Commission was mulling over what it should do with its first small-tract-proration fracas since the Normanna decision.

Shell Oil Co. has asked the commission to adopt 100%-acreage allocation in field rules for Southeast Quitman oil field in Wood County (OGJ, Apr. 17, p. 85).

The field, a 220-acre oil pool discovered in September 1959, has seven wells. One of these, a triple completion in the Kirkland, Rodessa, and Gloyd zones, is operated by an independent, C. A. Green, on a 1-acre lease.

Prior to the Normanna decision, the commission automatically would have adopted a proration policy based 50% on the well and 50% on acreage.

Shell contends that the Green well, under the 50-50 formula, would drain nearly $400,000 worth of oil from adjoining normal-size leases.

Ceiling Set on Mexican Oil Imports

THE FLOW of exempt Mexican oil imports will be limited to 30,000 bbl. daily for the next 3 years.

This expected announcement (OGJ, May 1, p. 80) was made by Interior Secretary Stewart L. Udall last week.

Udall said that Pemex, the Mexican Government's oil company, had written him that it would impose such restrictions on its exporters beginning May 1.

The total will include a minimum of 10,000 bbl. daily of residual fuel oil. The remainder will be heavy crudes not exceeding 15° API gravity at 60° F.

Pemex said it would consult with the U. S. Government before implementing any further procedure which would cause an increase in exempt imports into the U. S.

Udall said the problem, which began last fall, became acute when Brownsville imports exceeded 50,000 bbl. daily in April.

Leases Offered in Alaska

- **Bidders will get crack at both onshore and offshore acreage, including part of Cook Inlet Bombing Range.**

ALMOST 300,000 acres of wildcat land in Alaska is up for leasing.

Most of the land is within the limits of the old Cook Inlet Bombing Range in a part of Alaska familiar to oil men. The acreage is about 40 miles northwest of Swanson River oil field on the Kenai Peninsula and about the same distance west of Anchorage.

The land will be offered in two lease sales:

. . . **May 23** bids will be opened on 93 parcels covering 58,907 acres a few miles northwest of Tyonek. Another 40,000 acres of offshore land in Pavlow Bay near the end of the Alaska Peninsula and in Controller Bay in the Gulf of Alaska also will be offered.

This land is covered by the Mental Health Lands provision of the Alaska Land Act and is subject to competitive bidding.

. . . **July 25** lots will be drawn for 82 tracts covering 197,209 acres in the west part of the bombing range. This will be non-competitive leasing with no bonus bidding.

Interest is expected to be high on the bombing range land since it is within the Cook Inlet tertiary province and just across the inlet from Swanson River. The state says 13 companies have participated in seismic work done in the area.

The most recent wildcatting in this part of Alaska was done last fall by Union Oil Co. and Ohio Oil Co. The companies drilled two dry holes in the Knik Arm area.

Current wildcats . . . A disappointing report has been received on the 1 Falls Creek wildcat being drilled on the Kenai by Standard Oil Co. of California and Richfield Oil Corp.

The rig has been moved off and a workover rig has taken over to test the top portion of the hole for gas. The bottom 5,200 ft. of the hole was abandoned earlier. The well was whipstocked under Cook Inlet to a total depth of 13,789 ft., then plugged to 8,594 ft. for testing.

A gas discovery is one thing the Kenai doesn't need. Union and Ohio stopped drilling to the north of Falls Creek after completing five gas wells in Kenai field. The companies said they had proved up more than enough gas to meet demand.

Texas embarks on refund of taxes to gas pipelines

FOR THE SECOND time in recent history, Texas is returning to gas pipelines a huge amount of money it collected via an unconstitutional "severance-beneficiary" tax on gas.

Last week Judge Jack Roberts, State District Court in Austin, signed tax-warrant refunds totaling $2,950,203.72 for pipelines which successfully fought the tax.

The state will refund nearly $15,000,000 to more than 80 companies before the slate is cleared. This money was collected under a beneficiary tax of 15% of gas value at the wellhead. The tax was passed by the 1959 legislature and went into effect in September of that year.

It was originally declared unconstitutional by Judge Roberts. His decision was upheld by the state supreme court, and the state recently decided to make no further appeal.

Texas lost a similar bout with transmission companies over the same kind of tax in 1953. That time it was forced to refund more than $30,000,000 in protested payments when the U. S. Supreme Court declared the tax an illegal burden on interstate commerce.

Despite the two defeats, Texas legislators aren't ready to quit. Bills pending in the current legislative session would reimpose a beneficiary tax. One measure is strongly backed by Gov. Price Daniel. He contends it would stand up in court.

Daniel sponsored a "severance-beneficiary" tax bill which was bypassed by the 1959 legislature in favor of the measure which has now been declared unconstitutional.

Industry Near Agreement on Gas Bill

• IPAA meeting is told that draft of new natural-gas measure will be ready soon. Reported highlights: FPC to treat gas as a commodity, utility cost-of-service method couldn't be applied to individual producers.

THE IPAA is pinning its hopes for new natural-gas legislation on the prospect of an agreement by leaders of the producing, transmission, and distribution segments of the industry about the provisions of a bill.

Such an agreement, together with an outline draft of a new law, is expected to be accomplished within the next 4 to 6 weeks.

IPAA President Alvin C. Hope made this report to the association's gas committee at the IPAA's mid-year meeting last week in New Orleans.

The project is in the hands of a so-called tri-party task force or harmony group.

In the group are three representatives from the American Gas Association for distributors, three from the Independent Natural Gas Association of America for interstate pipelines, and one each from the American Petroleum Institute, Mid-Continent Oil and Gas Association, and Independent Petroleum Association of America for producers.

The group has been working quietly for nearly 2 years. Hope said that recently it has increased the frequency of its meetings and appears to be very close to final agreement.

He declined to reveal any details of the proposed bill. But other sources said the measure would direct the Federal Power Commission to regulate gas as a commodity and would forbid the agency to apply the utility cost-of-service rate-base method to individual producers.

On the strength of this prospect for early industry agreement, the IPAA voted to continue the joint effort. This was in contrast to its position a year ago when its officers were instructed to press for enactment of a purely producer-oriented bill.

President Kennedy's proposal to exempt small gas producers and concentrate regulation on the larger ones got no sympathy whatever from any member of the gas committee.

With almost no discussion, the committee voted unanimously to oppose the plan. Its resolution was endorsed by the IPAA membership without debate.

The current attempt of FPC to set gas prices on an area basis was noted as an admission that the utility approach is a failure. But a committee report questioned the legality and workability of the area-pricing approach.

Attitude of Congress . . . Hopes for favorable gas legislation within the relatively near future were increased by a congressman's address to the IPAA.

Rep. Walter Rogers of Texas, a member of the House Interstate and Foreign Commerce Committee which handles such legislation, said a majority of the members of Congress are not wedded to utility-type regulation of gas producers. They are willing to give consideration to any promising alternatives, he added.

Rogers said the broad subject will be opened through hearings on President Kennedy's proposals to reorganize FPC and exempt small producers, and through hearings on a number of other pending bills which deal with gas regulation.

Area-pricing analyzed . . . A detailed analysis of FPC's area-pricing attempt was given by Clayton Orn, general attorney for Ohio Oil Co.

He said area rates for independent producers will work if the commission determines such rates on the basis of the reasonable market price of gas and the reasonable revenue requirements of the gas-producing industry as a whole.

But the attempt is doomed to dismal failure if FPC applies utility-type methods to groups of producers, Orn declared.

Orn's solution: Let FPC fix reasonable prices in the field on the basis of the market price for gas, primarily by acting as arbiter of disputes on whether prices are above the market. Also, let the agency be the judge of whether prices are higher than reasonably necessary to maintain a balance between supply and demand.

Orn said that under this approach, FPC might reject a price as being above the market if it thought supplies could be purchased at lower prices.

On the other hand, he said, an advance in the market price would not be denied when such an increase is necessary to supply capital for additional exploration.

In answer to complaints that this would be no regulation at all, Orn asserted that such an approach would give FPC more power over a commodity than is now exercised by any federal agency.

He stressed that his plan would maintain competition in the gas business if FPC applied its yardsticks to broad segments of the industry.

Direct Gas Sales Attacked

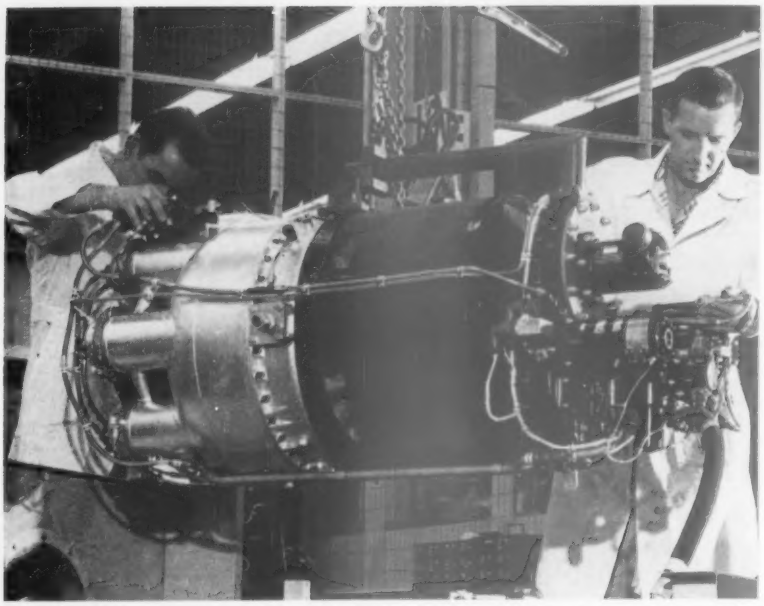
A BILL introduced in the California Legislature would kill the direct sale of gas by a producer to a customer in a gas utility's franchise area.

Southern California Edison Co. is buying gas directly from Richfield Oil Corp. for two plants in the franchise area of Pacific Lighting Gas Supply Co. subsidiaries.

Such sales would be prohibited under the proposed bill, but the measure would permit gas producers to sell directly to any customer outside a franchise area.

Pacific Lighting has attacked Richfield's sales, contending its franchise gives the utility the right to serve all customers.

The bill introduced recently would cover new contracts only. Present deals would be exempt.



GAS TURBINE, being assembled at AiResearch plant, is one of several types that will soon be competing with reciprocating engines in oil fields.

Gas Turbines Get New Push

. . . toward competition with reciprocating engines in oil fields, as Mission Manufacturing teams with AiResearch.

THE GAS TURBINE is inching toward its long-heralded entry into routine oil-field service.

Providing the push: An old-line oil-equipment manufacturer who has teamed up with an aircraft-turbine manufacturer.

The new team intends to put its packaged gas turbines into direct competition with conventional reciprocating engines for many oil-field drives.

The team includes Mission Manufacturing Co., Houston, and AiResearch Manufacturing Co., a subsidiary of the Garrett Corp., Los Angeles.

Mission will package, sell and service turbines manufactured by AiResearch.

The venture is Mission's first in the prime-mover market and AiResearch's first big move to put its turbines into any industry outside the aircraft field.

At a demonstration last week in Houston, Mission and AiResearch showed three basic types of packages.

One is a unit designed to deliver only shaft power, as does a conventional engine. In the demonstration a 160-hp. turbine weighing only 190 lbs. drove a centrifugal water pump.

Another unit delivers only compressed air. The compressed air is excess which the turbine generates in normal operation.

Such a package can supply air for internal cleaning of pipelines, for sand blasting or for air drilling.

Mission expects that turbine-compressed air will help expand the market for the air-hammer drill it already has in field service.

A third unit can deliver both compressed air and shaft horsepower. Mission and AiResearch say a great number of oil-field jobs can be done well and cheaply by such a unit.

Primary sales point for the gas-turbine packages: The light weight for the horsepower and air-pressure delivered.

For instance, a 4,000-lb. turbine unit could deliver as much compressed air as a 38,000-lb. diesel engine-compressor package.

Also, a wide variety of fuels from natural gas to heating oils can be used in the turbine.

The companies plan to add reheating-cycle equipment to some turbine packages. Result, they say, could be a fuel bill only half that of conventional diesel engines.

Regular octane hits lull after spurting upward

THE RAPID RISE in regular-gasoline octane appears to have been checked, at least for the time being.

Average regular octane in April, according to Ethyl Corp.'s nationwide survey, was 92.6 research octane number or 0.2 RON above April 1960. It has held at this level since last November.

On a motor basis, April regular was 84.4—0.1 number below March but unchanged from a year ago.

Premium gasoline averaged 99.3 RON, unchanged from March and 0.1 below a year ago. It averaged 89.8 on a motor basis, unchanged from March and 0.1 above a year ago.

Average tetraethyl lead contents in April were 2.28 ml. per gal. of premium gasoline and 1.57 ml. per gal. of regular.

The new emphasis of automobile designers on engines which will burn regular has shifted the pressure from premium to regular octanes. And the premium-regular spread has been narrowed to the smallest gap since 1953.

PROCESSING

A new acetylene process will be offered to the industry by Delhi-Taylor Oil Corp. and Hydrocarbon Research, Inc. The two companies have agreed to pool certain patents and technology to provide the process that purportedly will produce highly purified acetylene with higher yield and less oxygen consumption than existing processes. Hydrocarbon Research will be the licensing agent for the Delhi-HRI process.

Expanded gas-processing facilities have been put on stream at Union Texas Natural Gas Corp.'s Eunice, La., plant. The low-temperature absorption-type plant now has a gas capacity of 800,000 M.c.f.d. and

FPC Cost-Data Showdown May Be Years Away

IT COULD EASILY be a year or longer before the Federal Power Commission comes to grips with the key problem of the type of cost data that will be required in area-price hearings.

After that, more time would elapse while the commission held hearings and reached a decision.

Still more time would be required for the court tests that seem inevitable.

All in all, it appears that practical application of an area-pricing approach is years away — even if the plan is not scuttled by a new majority at the commission or by congressional action.

Any hopes for faster action have been dimmed by the failure of prehearing conferences to make any real headway in reaching agreement between various factions on cost data.

A recent on-the-record conference made no more progress than had been made in an off-the-record attempt or in the initial meeting in Midland (OGJ, Mar. 13, p. 84).

Edward B. Marsh, chief FPC hearing examiner, is now writing a report on the conferences. After he submits it, the commission will decide what to do next.

Bid for hearing . . . A group of producers has asked FPC to proceed with a hearing on the Permian basin, and has suggested a starting date of July 17.

Even under the plan suggested by the producers, however, it is unlikely that the cost-information problem would be taken up before next spring.

In a July hearing, if one is held, the producers would present broad economic information concerning the Permian basin and its place in the nation's gas picture. Cost data, as such, would not be involved.

If this happens, there would probably be a recess after the presentation to give the FPC staff and others time to prepare questions for a cross-examination. Then a date for resumption of the hearing would be set.

By September, at best, producers might be given an opportunity to present their second set of economic data—this time going into more detail but still not getting involved with cost data.

Once again, the cross-examination pattern would follow, so that it would be the end of the year before the commission would be able to get to the question of specific cost information.

Qualified observers doubt that the agency will be able to move that fast. They figure mid-1962 is much more likely.

Issue wide open . . . Currently, the cost-data question is virtually wide open. The FPC has ruled out cost-of-service data of the type required in strict utility-type regulation. But it has emphasized that it must have some cost information in determining area prices.

The stumbling block at the prehearing conferences was largely over whether individual cost data would be required or whether group cost data would suffice.

Most of the producers directly involved appear willing to provide detailed cost information. But they want it submitted as a group, with individual company figures available only to the commission.

Another group, led chiefly by distributing companies and consumer groups, insists on the right to call for individual company data when they feel it is needed. Their apparent intent is to examine the individual records of the larger producers in a given area.

The producer group has balked at this, saying it would simply mean a return to the old case-by-case approach, or that it would unfairly apply the averages of a few producers to all producers.

That's how the situation stands, with neither side seeming willing to yield further. Thus a slow procedure looms—with no end in sight.

BRIEFS . . .

is producing 307,000 gal. of ethane, and 550,000 gal. of LPG and natural gasoline daily.

Carstairs Operators' Committee will more than double the size of its gas-processing plant near Carstairs, Alberta. An expansion has started which will boost the plant's gas output from 70 million to 200 million cubic feet a day. Fluor Corp. is slated to complete the work in November.

A new gas-processing plant has been placed in operation near Mineola, Kans., by Skelly Oil Co. The 25,000-M.c.f.d. plant is presently processing 15,000 M.c.f.d. of gas and recovering 10,000 gal. of propane and 15,000 gal. of natural gasoline daily.

Expanded facilities for ortho-alkylated antioxidants have been completed by Ethyl Corp. at Orangeburg, S. C. This will almost double the company's capacity for its principal antioxidants used by oil refiners and other industrial users. Also, Ethyl will be able to produce commercial quantities of other ortho-alkylated chemicals for the first time.

Construction is under way on a huge nitrogen fertilizer complex near Cherokee, Ala. When completed in early 1962, Armour Agricultural Chemical Co. will operate the six plants to produce 360 tons of ammonia, 50 tons of urea, 300 tons of nitric acid, 250 tons of ammonium nitrate, 500 tons of ammonium phosphate, and 250 tons of nitrogen solutions daily. Hydrogen requirements will be obtained from natural gas.

Work will start this month on a 20,000-bbl. Isocracking unit at Tidewater's Avon refinery near San Francisco. Bechtel Corp. has won the $20-million contract. The Isocracking plant also will include a 20,000-bbl. catalytic pretreater and a 50-million-cubic-foot hydrogen plant. The units will go on stream in mid-1962.

How Stripper-Well Output Looks in Latest Study

State—	No. of Stripper Wells	Production 1959 (bbl.)	Abandonments	Average Daily Prod.	Prod. Acres	Reserves (Thousands of bbl.) Primary	Secondary	Total 1-1-60
Arkansas	4,791	8,700,174	15	4.98	66,135	43,730	45,980	89,710
California	21,317	60,908,964	176	7.83	136,370	688,093	507,250	1,195,343
Colorado	391	1,356,087	25	9.50	15,980	10,595	1,435	12,030
Illinois	28,430	76,458,600	805	7.37	567,125	*586,709		586,709
Indiana	4,744	10,470,583	71	6.05	71,000	52,350	39,500	91,850
Kansas	35,400	56,705,152	1,432	4.39	878,000	318,998	96,685	415,683
Kentucky	11,275	13,442,075	200	3.27	31,120	53,500	40,000	93,500
Louisaina	9,182	12,357,903	337	3.69	204,186	98,800	69,800	168,600
Michigan	3,373	10,438,608	115	8.48	160,077	73,747	109,295	183,042
Mississippi	182	834,971	40	12.57	7,250	6,680		6,680
Missouri	121	75,070	5	1.70	1,890	575		575
Montana	3,077	3,675,040	0	3.27	104,377	33,651	111,143	144,794
Nebraska	58	138,779	28	6.56	2,830	930	1,750	2,680
New Mexico	1,226	2,386,494	10	5.33	67,370	19,088	37,000	56,088
New York	14,900	1,913,099	1,100	0.35	62,000	57,700	31,000	88,700
North Dakota	80	148,555	20	5.09	5,911	1,225	3,905	5,130
Ohio	16,934	5,978,000	677	0.97	147,915	53,900	5,000	58,900
Oklahoma	68,836	91,328,678	1,331	3.63	1,142,194	580,873	661,371	1,242,244
Pennsylvania	64,340	5,895,820	1,902	0.25	625,732	*113,574	†380,110	493,684
Tennessee	32	9,300	18	0.80	165	63		63
Texas	84,690	160,551,394	2,897	5.19	1,905,128	1,199,859	826,243	2,026,102
North Texas	27,589	41,673,839	1,201	4.14	415,920	354,108	356,200	710,308
West Central Texas	11,319	15,040,601	547	3.64	298,103	117,108	100,620	217,728
Other	45,782	103,836,954	1,149	6.21	1,191,105	728,643	369,423	1,098,066
Utah	15	10,197	7	1.86	860	80		80
Virginia	13	3,992	0	0.84	100	20		20
West Virginia	15,800	2,184,000	147	0.38	208,300	35,274	50,840	86,114
Wyoming	3,328	7,498,160	93	6.17	110,994	75,000	333,000	408,000
TOTALS	**392,535**	**533,469,695**	**11,451**	**3.72**	**6,523,009**	**4,105,014**	**3,351,307**	**7,456,321**

*Secondary reserves of projects now in operation included with primary reserves. †Estimated probable secondary recovery reserves.

Two-Thirds of All Wells Are Now Strippers

- Latest joint study shows a fifth of all U. S. oil is produced from wells making less than 10 bbl. daily—and number of such wells is rising.

OIL PRODUCERS abandoned 11,451 stripper wells during 1959. But during the year more than 30,000 wells moved into the stripper category.

As a result, the number of these marginal wells in the United States rose from 373,870 to 391,535 at the beginning of 1960.

These changes mean that at the beginning of last year stripper wells represented 67.2% of all producing oil wells in the U. S. and accounted for 21.4% of the nation's crude production.

These conclusions are drawn from the latest study of stripper wells, produced annually by the Interstate Oil Compact Commission with the cooperation of the Independent Petroleum Association of America and the National Stripper Well Association.

Other points in the study:

... **Production** from strippers rose 21.6 million barrels to a total of 533,469,695 bbl. in 1959.

... **Per well production** dipped slightly to 3.72 bbl. daily from the previous year's 3.75. The figure, however, still was well above average production of 3.5 bbl. in 1957, 3.59 in 1956, and 3.58 in 1955.

... **The 11,451 abandonments** were 1,663 more than the number abandoned during 1958.

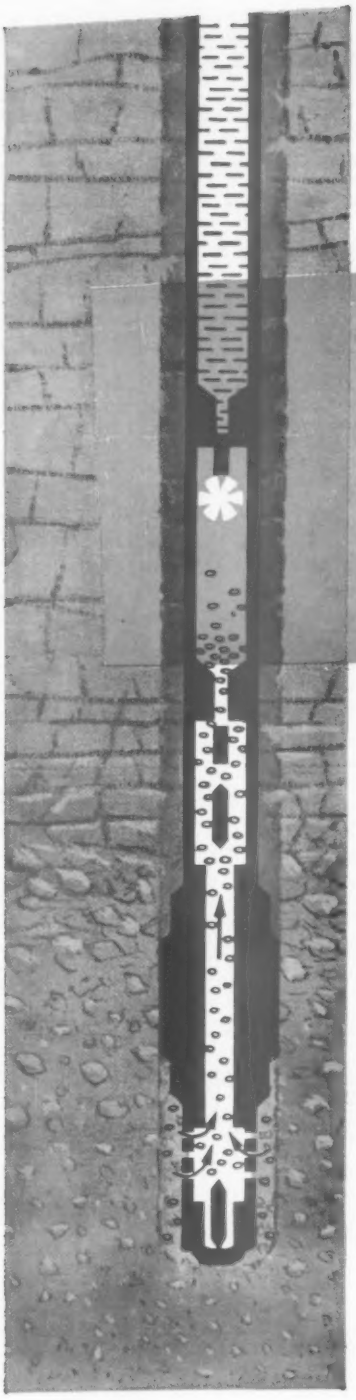
... **Reserves** in stripper fields rose 577 million barrels to a new total of nearly 7.5 billion barrels—or about 22% of total U. S. reserves. This total breaks down to 4.1 billion barrels of primary reserves and 3.35 billion barrels of secondary reserves.

Generally the study considers a stripper well to be one that produces less than 10 bbl. a day. It also includes all wells in nonprorated fields where the field average is below that amount.

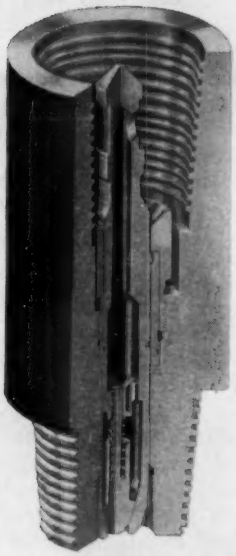
Also included are wells formerly classified as strippers which may now be producing more oil because of secondary-recovery operations. And in a few instances, wells may be considered strippers if they produce excessive amounts of water or if their oil output is low in proportion to well depth.

Mississippi topped the industry with an average of 12.57 bbl. per well per day. These wells are classed as strippers because of heavy water production and greater-than-average depth.

Pennsylvania in 1959 again claimed the dubious distinction of having the lowest per well output—0.25 bbl. per day.



now! find low pressure payzones



. . . Regardless of Water Cushion

When testing deep formations, the hydrostatic pressure of the water cushion used to keep the pipe from collapsing can often hide potential production in a *low pressure* zone.

THE NEW HALLIBURTON RETRIEVABLE BACK PRESSURE VALVE can help avoid passing up these payzones by supporting the water cushion so its hydrostatic head does not affect the formation pressure recordings. The Back Pressure Valve is retrievable by wire line.

LOOK AT THESE RESULTS

On a recent West Texas test where the hydrostatic pressure of the water cushion used exceeded 900 psi, the use of the Back Pressure Valve allowed the operator to obtain the following formation pressure recordings from the zone tested:

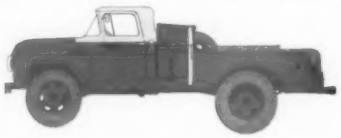
Initial flow pressure	110 psi
Final flow pressure	303 psi
Closed-in pressure	566 psi

Since all formation pressures were less than the hydrostatic pressure of the water cushion, it is obvious that, without the use of the New Halliburton Back Pressure Valve, no formation pressure would have been indicated and this potentially productive zone might have gone undetected.

ASK YOUR HALLIBURTON TESTER ABOUT THIS NEW INNOVATION!

TESTING SERVICES

Another first in Formation Testing!



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IPAA Now Expects Demand to Rise 1.5%

• Continued slump in the economy caused a cutback from last October's more optimistic view. But IPAA sees an upturn about to start.

SOME of the oil industry's top economists took a new look at the demand picture last week.

They decided that we're on the verge of a new upswing in business and predicted that demand this year will average about 1.5% better than 1960.

This was the conclusion of the supply - demand committee of the Independent Petroleum Association of America at its midyear meeting in New Orleans.

It is a sharp change from the committee's forecast last October of a 2.5% climb this year. The group indicated that the reasons for the revision were the slowness of the economy in pulling out of the recession that has been with us since last May and a lower than expected demand in the first quarter.

The economy, the report said, "now appears to be on the verge of an upturn."

The committee said the increase in demand will stem largely from a substantial increase in commercial jet - fuel requirements and greater gasoline and specialty-product sales.

Distillate will show only modest gains, while demand for residual may even decline, it concluded.

Slow quarter . . . The committee's new look at the demand picture came after the first quarter failed to come up to expectations. And estimates for the year were revised.

IPAA now expects total domestic demand to average 9,818,000 bbl. daily for the year compared with the earlier projection of 9,900,000 bbl. daily. Exports will average 175,000 bbl. daily.

Actual domestic demand for the first quarter was 235,000 bbl. daily less than the committee forecast last October. The declines occurred in distillates, 132,000 bbl. daily; kerosine, 26,000; residual, 11,000; and others, 75,000. Gasoline actually showed a 9,000-bbl.-daily increase.

The changes show that the original forecast by the IPAA group was a good one. Most of the first-quarter revisions were due to abnormal weather.

IPAA Forecast for 1961

(Figures in thousands of barrels daily except closing stocks)

	1960 (actual)	1961 Current forecast 1st Q.	2nd Q.	3rd Q.	4th Q.	Year 1961
Domestic Demand						
Gasoline	4,146	3,814	4,450	4,490	4,190	4,236
Kerosine	362	499	250	300	485	384
Distillate	1,874	2,613	1,410	1,250	2,265	1,885
Residual	1,531	1,889	1,305	1,180	1,575	1,487
Other	1,764	1,660	1,785	1,980	1,875	1,826
Total	9,677	10,475	9,200	9,200	10,390	9,818
Exports						
Gasoline	37	26	40	35	30	33
Kerosine	2	1				
Distillate	27	17	25	20	15	19
Residual	50	36	35	35	35	35
Other	86	85	90	90	90	88
Total	202	165	190	180	170	175
Total Demand	9,879	10,640	9,390	9,380	10,560	9,993
Stock Change	−83	−229	+336	+287	−522	−32
New Supply Required	9,796	10,411	9,726	9,667	10,038	9,961
Imports						
Crude	1,015					
Products	804					
Total	1,819					1,860
Production						
Crude	7,035	7,285	7,027	6,998	7,102	7,104
Gas liquids	942					997
Total	7,977					8,101
Closing Stocks (Million Bbl.)						
Gasoline	194.8	227.0	198.0	174.0	183.0	183.0
Kerosine	31.4	26.0	31.0	36.0	31.0	31.0
Distillate	138.5	90.0	117.0	165.0	136.0	136.0
Residual	44.9	42.0	43.0	50.0	46.0	46.0
Other Products and Nat. Gas Liquids	135.1	137.0	151.0	146.0	137.0	137.0
Crude Oil	*239.8	242.0	255.0	250.0	240.0	240.0
Total	*784.5	764.0	795.0	821.0	773.0	773.0
Runs to Stills	8,067	8,290	7,869	8,058	8,206	8,107

*New basis January 1, 1961.

For the rest of the year the committee expects petroleum domestic demand will share in the slow rise in the national economy.

The committee noted there are no significant forces present now comparable to those which brought rapid recovery from each of the past three recessions. For this reason they expect 1961 to be a year of limited growth.

Crude output . . . The current forecast calls for a crude-production rate of 7,104,000 bbl. daily for the year or a 1% gain over 1960.

Production of gas liquids is expected to increase 5.8% to 997,000 bbl. daily.

Imports for the year will depend on the government program for the last half of the year. This program has not been determined; but on the basis of the present program, imports should average about 1,860,000 bbl. daily, a gain of about 41,-

000 bbl. daily would take 25% of the total gain in new supply.

Inventories . . . The industry made some progress in reducing inventories in 1960 but may not do so well this year.

Product stocks dropped 12.9 million barrels and crude stocks dropped 17.3 million in 1960. These reductions brought total stocks down to 778.7 million barrels at the end of 1960, lowest since 1955.

The Bureau of Mines put some minor-product stocks on a new basis at the beginning of 1961 which revised total opening inventories upward to 784.5 million barrels.

In the first quarter of 1961, total stocks dropped only about 20 million barrels compared with an average drop of 58 million barrels in the same quarter over the last 4 years and a 10-year average drop of 40 million barrels.

The committee estimated that stocks would increase 31 million barrels in the second quarter and gain another 26 million in the third. A reduction of 48 million barrels is forecast for the last quarter.

Estimated reductions in inventories will not bring total stocks to target levels which the committee accepted as a sound standard last October. The latest projections, however, represent significant improvement from the current situation.

Texas Smoothing Insurance Loans to Oil Men

A BILL making it easier for life-insurance companies to loan money to oil and gas operators has been passed by both houses of the Texas Legislature.

Expected to become law soon, the bill would permit life and accident insurance firms to make direct loans to oil companies secured by production payments.

Insurance companies are one of the prime sources of oil-industry financing. Present law in Texas, however, forces them to make loans to oil firms through banks or dummy corporations.

Passage of the insurance bill was one of several actions taken by the legislature last week affecting the industry. Others involved:

. . . House approval of a bill by Rep. Sam Collins, Newton, which would require publication of notices on all Texas Railroad Commission hearings on oil and gas in newspapers of the counties affected.

. . . Committee clearance of a scaled-down version of Rep. Robert Eckhardt's new blanket-type gas tax on producers and pipelines. The bill—now ready for early House action—is another attempt to levy a constitutional tax on the gas pipelines.

It would retain the present gas-production tax of 7% of wellhead value. But it would require the holder of a dedicated-reserve contract to pay a tax of 7% of the difference between the wellhead price and a price of 15 cents per M.c.f.

The measure would produce a tax of at least 1.05 cents on each M.c.f. of gas produced in the state. Gas selling for more than 15 cents would not pay any added tax.

Yield from this measure is estimated at $15,000,000 yearly. Eckhardt says he expects the tax to be attacked in court, if it is enacted into law.

. . . A step forward for a bill which would require gas pipelines to furnish gas to fuel irrigation pumps of landowners on which gas wells are located. The bill, defeated in several previous sessions of the legislature, was cleared for House action by the oil, gas, and mining committee.

New Resin Makes Wax Better

- **Du Pont product gives paraffin strength, bonding power that will boost it in the wrapper market.**

A NEW PRODUCT which makes paraffin wax far more versatile will emerge soon from Du Pont Co.'s Sabine River works at Orange, Tex.

Known as "Elvax" vinyl resin, the product is a copolymer of ethylene and vinyl acetate.

Du Pont says "Elvax" gives toughness, flexibility, and adhesive qualities to paraffin wax and other brittle materials of low molecular weight. Vinyl resins will make petroleum-based wax a stronger competitor against the newer flexible films and coatings, the company believes.

Heat-sealing properties of a wax mixture are greatly increased through the addition of 10% of the new material. And Du Pont says that when 30% or more is used in the wax blend, the mixture behaves more like a polymer than a wax.

Wax coatings which contain the resin do not have the brittleness of unmodified paraffin - wax coatings. The latter tend to flake and break when creased or flexed.

Because of the low price of wax, blends containing 30 to 40% of the resin are expected to cost only 22 to 27 cents a pound.

The new material will be a product of a high-pressure polyethylene plant which Du Pont will build at Orange. The company expects to have commercial quantities available later this year, although the plant will not be completed until late in 1962.

Du Pont expects its resin to find application in these areas:

. . . Wax additive. Field tests show that when the resin is used in waxed glassine and waxed bread wrap, it improves heat - seal bond strength and water-vapor-barrier properties two to four times. It makes food cartons more grease-resistant—up to five times as much as the coatings now used.

. . . Wax coatings. Blends of paraffin wax containing 30 to 40% of the resin can be applied to paper, film, and foil by hot-roll coating. The coating is completely flexibile and provides excellent water-vapor-barrier properties.

. . . Adhesives. Heat-activated coatings with the new vinyl resin are expected to find immediate use for end labels on pastry and bread wrappers.

Refinery Runs Pared by Southwestern States

- Four per cent cutback made in March, leaving area crude runs at an average of 3,376,461 bbl. daily. Nationally the month's cut was 4.4%.

DURING MARCH, refiners in five Southwestern states cut back runs 4% from the February figure as product stocks mounted. Area crude runs averaged 3,376,461 bbl. daily.

Although runs were down from February, they were up 4.4% over March a year ago.

Nationally refiners followed the same pattern, cutting crude runs 4.4%. The national figure of 8,041,000 bbl. per day was a drop of 372,000 bbl. from February. And it was the first cut in runs in 3 months.

On a capacity comparison, southwestern refiners operated their plants closer to top ratings. During March the five-state area operated at 90% of calendar-day capacity. Nationally the figure was 81%.

The 90% level was one of the highest in the country, although the level was exceeded by refiners in the Minnesota - Wisconsin - Dakota area. They operated at about 92% of capacity, while the East Coast and West Coast maintained runs at about 74% of capacity.

ARKANSAS

(Refinery Runs in Barrels Daily)

Company and location—	March	February	March 1960
American, El Dorado	39,744	40,619	37,009
Lion, El Dorado	34,132	35,336	29,591
MacMillan, Norphlet	2,557	3,607	2,061
Other	6,001	6,335	4,666
Total Arkansas	82,434	85,897	73,327

LOUISIANA

Cities Service, Lake Charles	165,028	175,068	175,019
Continental, Lake Charles	51,693	59,505	45,893
Humble, Baton Rouge	293,761	342,702	280,116
Ingram, Meraux	19,427	20,316	17,494
Shell, Norco	97,986	98,333	94,873
Tenneco, Chalmette	44,833	45,156	26,292
Other	8,116	8,836	8,269
Total Louisiana	680,844	749,916	647,956

MISSISSIPPI

Paluxy, Yazoo City	1,294	1,192	1,196
Pontiac, Hattiesburg	16,150	16,415	14,907
Southland, Sandersville	4,655	4,366	3,772
Total Mississippi	22,099	21,973	19,875

OKLAHOMA

Allied, Stroud	1,736	2,877	2,782
Anderson-Prich., Cyril	10,256	9,441	10,379
Bell, Grandfield	6,474	6,571	6,813
Ben Franklin, Ardmore	10,947	8,304	11,783
Champlin, Enid	29,456	26,553	27,559
Cities Service, Ponca City	31,508	30,084	30,580
Continental, Ponca City	59,463	64,810	63,180
DX Sunray:			
Duncan	39,394	40,220	33,242
Tulsa	70,012	70,469	67,737
Kerr-McGee:			
Cushing	18,271	18,287	23,057
Wynnewood	17,912	17,983	15,786
Midland Co-op., Cushing	12,074	13,243	12,808
Phillips, Okmulgee	15,106	13,061	16,666
Texaco, Tulsa	*	*	*
Total Oklahoma	322,609	321,903	322,372

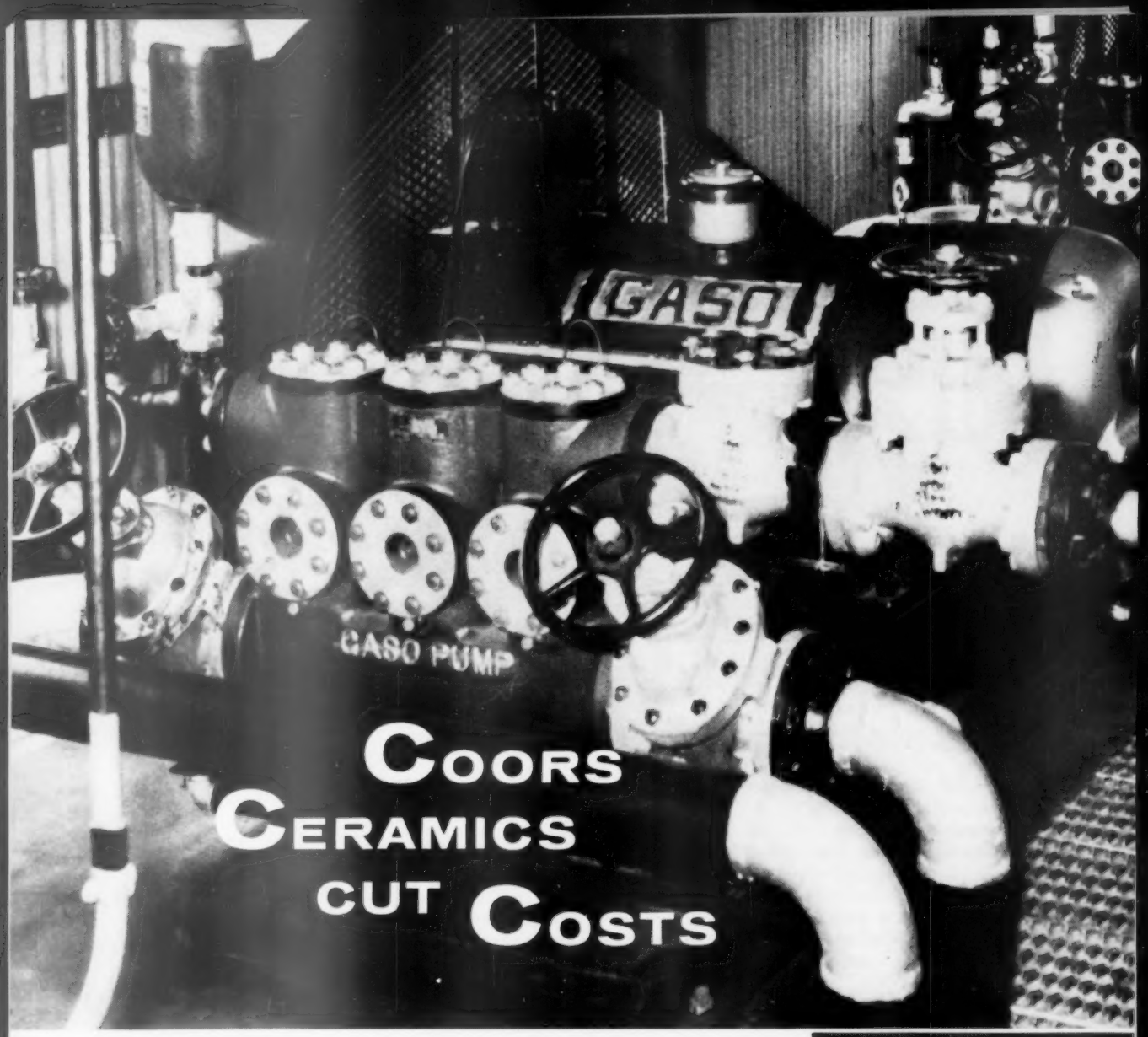
*Not reported to Oklahoma Corporation Commission.

TEXAS

(Refinery Runs in Barrels Daily)

Company and location—	March	February	March 1960
American, Texas City	117,755	142,604	84,493
Am. Petrofina:			
Mount Pleasant	17,099	15,159	14,140
Wichita Falls	4,894	6,633	6,334
Atlantic, Port Arthur	62,346	64,453	63,849
Col-Tex, Colorado City	7,560	7,681	7,061
Continental, Wichita Falls	11,099	9,459	11,403
Cosden, Big Spring	28,522	28,805	28,723
Crown Cent., Houston	34,549	34,990	24,916
Delhi-Taylor			
Corpus Christi	40,339	43,066	34,402
Port Isabel	5,750	5,266	6,357
Eddy, Houston	2,101	2,015	1,917
El Paso, Odessa	12,669	11,158	13,684
Gulf, Port Arthur	254,802	278,741	263,590
Howell, San Antonio	1,994	2,208	2,287
Humble, Baytown	282,500	292,306	286,806
La Gloria, Tyler	16,399	16,896	15,314
Mobil, Beaumont	205,855	208,352	201,471
Phillips:			
Phillips	70,470	57,496	59,822
Sweeny	58,848	74,037	71,055
Plymouth, Texas City	35,377	35,069	26,821
Pontiac, Corpus Christi	51,461	48,213	45,259
Premier:			
Fort Worth	7,798	7,787	7,748
Longview	3,110	3,237	4,531
Pure, Nederland	83,253	84,070	70,964
Shamrock, Sunray	23,329	19,338	22,872
Shell, Houston	104,733	127,798	108,265
Signal, Houston	*53,202	48,182	44,726
Sinclair:			
Corpus Christi	22,220	19,900	31,466
Houston	124,653	127,821	130,080
Skelly, Longview	1,545	3,039	1,526
Southwestern, Corpus Christi	30,799	31,145	37,706
Stand. Tex., El Paso	52,253	51,353	47,461
Suntide, Corpus Christi	40,768	43,487	42,908
Texaco:			
Amarillo	17,118	16,653	9,861
El Paso	8,445	7,406	11,995
Port Arthur	*267,581	267,871	*248,773
Port Neches	44,291	37,201	31,599
Texas City, Texas City	32,100	34,514	25,754
Other	28,888	22,670	22,640
Total Texas	2,268,475	2,338,079	2,170,579

*Includes condensate.



COORS CERAMICS CUT COSTS

You, Too, Can Cut Pump Maintenance Costs By Using Coors Ceramic Plungers. Coors Ceramic Plungers, 2-¾" diameter, were installed in this GASO Figure 3466 Horizontal Triple Plunger Pump when it was placed in water flooding service June 1, 1957, operating at 225 RPM against 900 PSI. In 1960, after 1,504,320 barrels of salt water had been discharged, it was found that only $73.89 had been spent on maintenance. This expenditure was for repacking the plungers three times—after 7-½, 15 and 27-½ months' service. The original Coors Ceramic Plungers are still in regular service in this pump. All leading builders of plunger pumps have Coors Ceramic Plungers available—normally from stock. Please ask the builder of your pump for Coors Ceramic Plungers to help you cut pump maintenance costs.

Coors

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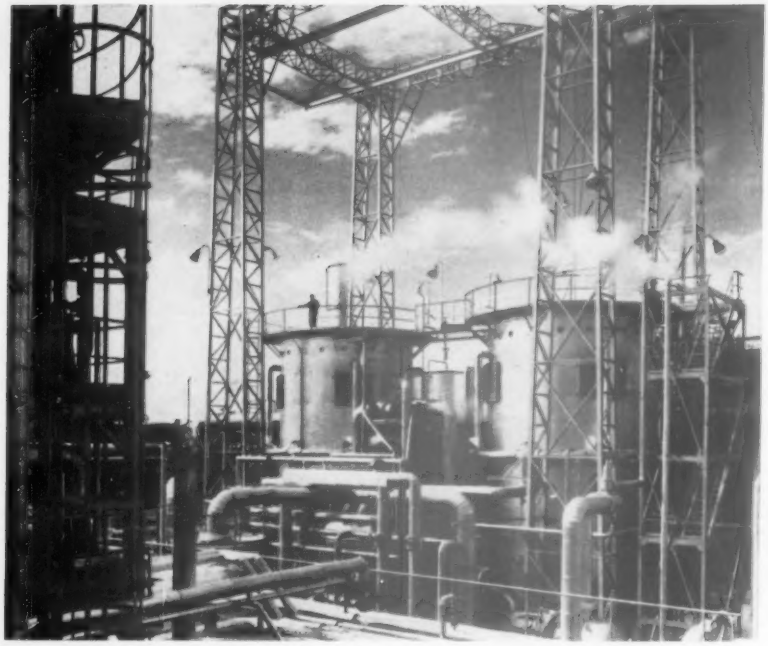
GASO PLUNGER
OF COORS CERAMIC



HIGH-PRESSURE furnace at this French ammonia plant operates at 250 psig.

Gas-Reforming Advance Made

A MAJOR breakthrough in gas reforming is claimed for a high-pressure furnace operating at 250 psig. in an ammonia plant in southern France.

Chemical Construction Corp., which designed and built the furnace, says no gas reformer in the world had ever operated at pressures above 175 psig. before this installation was placed on stream.

The new design eliminates the need for one of the many compression stages usually required in a plant of this type. It also improves heat recovery in the combined gas-reform and CO_2-removal system.

Chemico constructed the furnace for the Office National Industriel de l'Azote (ONIA).

High Court Favors Gas Lines

NATURAL-GAS-PIPELINE companies will not be required to pass along immediately to consumers any benefits from fast tax writeoffs.

This was the effect of the U. S. Supreme Court's action last week when it refused to hear a case in which the Federal Power Commission was challenged for making such a ruling.

The question arose in 1959 after the FPC approved a rate request by El Paso Natural Gas Co.

In establishing its rate base, the company used a straight-line method of depreciation—spreading the depreciation deductions equally over the life of the facilities.

For actual tax-paying purposes, however, the company used a fast tax writeoff. This gave it a larger deduction in the early years.

California appealed FPC's decision to permit the company to do this. The state's argument was that the company's savings in tax payments in the early years of depreciation should be passed on to the consumer in the form of lower rates.

The company pointed out that this would kill the benefits of the fast-tax-writeoff program. It said that higher rates to consumers eventually would result as the tax burden increased in the later years of the life of the equipment.

El Paso argued that in the long run a company pays the same taxes whether it uses the fast-writeoff method or straight-line depreciation.

That is, the larger deduction during the first 5 years of a fast write-off is offset by a proportionately smaller deduction during the remainder of the life of the facilities.

The sole advantage—unless tax rates should be reduced—is that the company has more funds available for use during the 5-year period.

The FPC, recognizing this, rejected California's argument. The state appealed. Now the Supreme Court has upheld the FPC by refusing to review the agency's decision.

Gulf to Drill off Florida

GULF Oil Corp. will give offshore Florida another try.

Next week Offshore Co.'s Rig 52 will spud the third well drilled in a huge area near Key West.

The area was leased in August 1959 by Gulf and the California Co. Two earlier tests were dry (OGJ, Dec. 19, 1960, p. 51).

The new well will be about 44 miles west-southwest of Key West in Block 46.

Rig 52 will operate in 55 to 60 ft. of water from a self-contained mobile drilling platform.

INDUSTRY

A deal for Humble to buy production and some other assets of West Central Drilling Co., Abilene, Tex., reportedly has been made but details have not been released. West Central owns interests in 224 oil and gas wells in Texas and also operates five drilling rigs. Purchase is expected to be concluded about June 1.

By-passing a new depth-acreage formula, the Oklahoma Corporation Commission has fixed the state's oil allowable for May at 15 bbl. daily. This will produce an estimated 520,000 bbl. daily, compared with 546,197 bbl. in the first 22 days of April under a 17-bbl. rate. The commission went back to the old schedule because it lacked information on many Oklahoma wells and therefore

Nation's Crude Surplus Is Still Growing

• Ability to produce crude now tops production by 27%, IPAA study shows. There's a surplus, too, in gas liquids.

PRODUCERS in this country could jump their crude-oil output by more than 2,500,000 bbl. a day if the occasion demanded it.

And they could keep it up for 6 to 12 months, or more, without any further drilling. And without the threat of reservoir damage or significant loss in ultimate recovery.

These are the conclusions of the productive-capacity committee of the Independent Petroleum Association of America presented at the association's midyear meeting last week in New Orleans.

The committee found that productive capacity has climbed 258,000 bbl. daily in the past year, with crude oil accounting for 184,000 bbl. of this and natural-gas-liquids the rest.

A similar hike this year would further increase the surplus. The IPAA now estimates the gain in demand for 1961 at only 1.5% (see p. 72).

This latest in a long series of yearly additions now gives the nation a productive capacity of 9,892,000 bbl. daily of crude and 1,041,000 bbl. daily of gas liquids. Since crude-oil production in January was only 7,210,000 bbl. daily, the committee figures that 27% of the nation's crude-producing capacity is surplus.

Gas-liquids surplus capacity was set at 42,000 bbl. daily, or only 4% of the industry's ability to produce.

The increase in crude-oil capacity was the largest in 4 years. During 1957, the committee said, the nation added 243,000 bbl. daily to its ability to produce.

Biggest year in the 8-year continuing study was the first—1954. In that year, the committee calculated, the crude-oil productive capacity of the U. S. climbed from 7,926,000 bbl. daily to 8,442,000.

How productive capacity has grown

Capacity of U. S. Wells on January 1
(Thousands of barrels daily)

	1956	1957	1958	1959	1960	1961
Crude Oil and Lease Condensate						
Dist. 1	38	35	34	27	28	28
Dist. 2	1,532	1,560	1,549	1,542	1,534	1,526
Dist. 3	5,690	5,990	6,225	6,367	6,476	6,668
Dist. 4	569	585	625	670	670	700
Dist. 5	1,100	1,080	1,060	1,050	1,000	970
Total U. S.	8,929	9,250	9,493	9,656	9,708	9,892
Processed Natural Gas Liquids						
Dist. 1	14	15	14	16	20	26
Dist. 2	140	145	145	131	140	170
Dist. 3	560	580	605	660	685	725
Dist. 4	13	15	21	28	32	35
Dist. 5	98	95	95	95	90	85
Total U. S.	825	850	880	930	967	1,041

BRIEFS . . .

found it impossible to use the depth-acreage formula (OGJ, Jan. 23, p. 48).

Shipments of LPG in "jumbo" tank cars under sharply reduced rail rates have begun. Kansas City Southern Lines reports the first movement was in a 30,000-gal. car from Lerch, Ark., to St. Louis, at a new rate of 1.5 cents per gallon compared with 2.8 cents per gallon under the previous schedule for cars of that size.

Liquidation of Husky Oil & Refining, Ltd., a subsidiary of Canadian Husky Oil, Ltd., has been announced. The parent firm will take over Husky's exploration, production, refining, and marketing activities in western Canada.

A chain of 87 service stations in Long Beach has been purchased by Tidewater. This is the company's second chain acquisition in southern California in recent months. Tidewater recently bought 67 Community stations in Los Angeles. The latest purchase was from Barnes & Rogers, Inc., a long-time Flying A distributor.

Kansas' crude allowable for May has been set at 300,000 bbl. daily, a drop of 5,000 bbl. from the April level.

Plans for partial liquidation of Felmont Petroleum have been shelved because of tax difficulties. Instead, the company will offer stockholders $6.75 per share for 45% of their stock. This will allow outside stockholders to obtain their share of net cash proceeds from a sale of U. S. and Canadian oil-producing leaseholds and other properties to Cities Service.

A regional exploration base is being established at Denver by Monsanto Chemical's Lion Oil division. Lion, which has headquarters at El Dorado, Ark., will move all of its geologists at Casper, Wyo., and Durango, Colo., to the new base. A district land office at Durango will be shifted to Denver, but a land office at Casper will remain there.

Sale of Douglas Oil Co. of California to Continental Oil on an exchange basis of one share of Continental stock for each five shares of Douglas has been approved by the latter company's stockholders. The Douglas name and present management will be retained.

Australian Oil Find Whips Up Waves

UNION OIL has rekindled oil fever in Australia with an 80-bbl.-daily discovery in the Great Artesian basin.

The find is the most encouraging well since the flash-in-the-pan discovery at Rough Range in 1953.

It caused a wild melee on the floor of the Sydney Stock Exchange and the heaviest trading in oil stocks since Rough Range.

Doyle Graves, manager of Union Oil Co. of California operations in Australia, said initial tests on the Cabawin 1 well yielded a flow of 80 bbl. daily of 48°-gravity crude and 650,000 cu. ft. daily of gas. Tests are continuing.

The wildcat is located west of Brisbane near Tara, Queensland. It is the first wildcat drilled by Union on a 40-million-acre block.

The crude may have been recovered from a zone at 9,935 ft., where Union encountered a strong gas kick earlier. Total depth of the well is 12,035 ft.

The well reportedly is on the flank of a large structure.

Reese Taylor, Union Oil chairman, emphasized it was too early to determine whether the well would be commercial.

"We are continuing to test the well," Taylor said. "Data are still inconclusive and the potential cannot be accurately assessed until production tests are completed."

The Queensland Minister for Mines, Ernest Evans, said the Cabawin find was flowing at the rate of 90 to 100 bbl. daily. Australia's Minister for National Development, Sen. William Henry Spooner, described the well as "encouraging."

Union's partners in the program are Kern County Land Co. and Australia Oil and Gas Corp. The group holds exploration rights to a total of 72,300 sq. miles in Queensland and New South Wales. Union is the operator.

Profit split . . . Under the partnership agreement, the Australian company is to receive 20% of any profits, while Union and Kern are sharing costs on a 50-50 basis. The Australian company is furnishing administrative services and staff at cost.

The government may pay some of the costs of the test with a subsidy of up to $400,000, payable technically to Australia Oil and Gas, the concession holder.

This could be done under the Petroleum Search Subsidy Act of 1959, designed to keep exploration interest alive in the country.

The subsidy was approved last year by the Ministry of National Development before the test began. But payment will be made only if the well is non-commercial. If the test proves commercial, there will be no payment.

A commercial-size oil field would have a ready market. Consumption last year was up nearly 9% to 220,000 bbl. daily, every drop imported.

Another deep well test was spudded last week about 250 miles west of Cabawin 1.

The new wildcat, Buckabie No. 1, is scheduled to go to 12,000 ft. The concession being tested is held jointly by Phillips Petroleum and Sunray Mid-Continent.

These two companies have an interest in 52 million acres in Queensland.

Rough Range, and after . . . The Rough Range 1 discovery in December 1953 still is talked about as one of the industry's classic fizzles.

The well, the first tested in western Australia by WAPET, came in as a 550-bbl.-daily producer. But successive tests on the structure were dry holes.

WAPET was owned by Caltex and AMPOL, a local firm. Royal Dutch - Shell has now joined the firm, which still is active in western Australia.

The Rough Range find, together with small gas finds has helped spur exploration programs year after year despite the lack of a commercial find.

Eighty companies or individuals hold concession rights covering 1.5 million sq. miles of sedimentary basin areas.

Farmout arrangements have been made on many of the concessions, and the total number of companies with an interest in the Australian oil play is much larger.

The present search is marked by a shift in interest to eastern Aus-

There's Plenty of Geology Down Under

MANY of Australia's 28 known basins still are unexplored.

So far, the best gas flow has been at Pickanjinnie 1, Roma, Queensland, from Mesozoic rocks at 4,007-25 ft. Three gas sands have been found in the basal Mesozoic (Triassic).

Australia's first big oil discovery was WAPET 1 Rough Range on the west coast in the northern part of the Carnarvon basin. Flow was from the Cretaceous at 3,605-20 ft.

Union's new hit, Cabawin 1, was drilled to determine whether the younger Paleozoic rocks of the Bowen syncline extend beneath the eastern lobe of the Great Artesian basin.

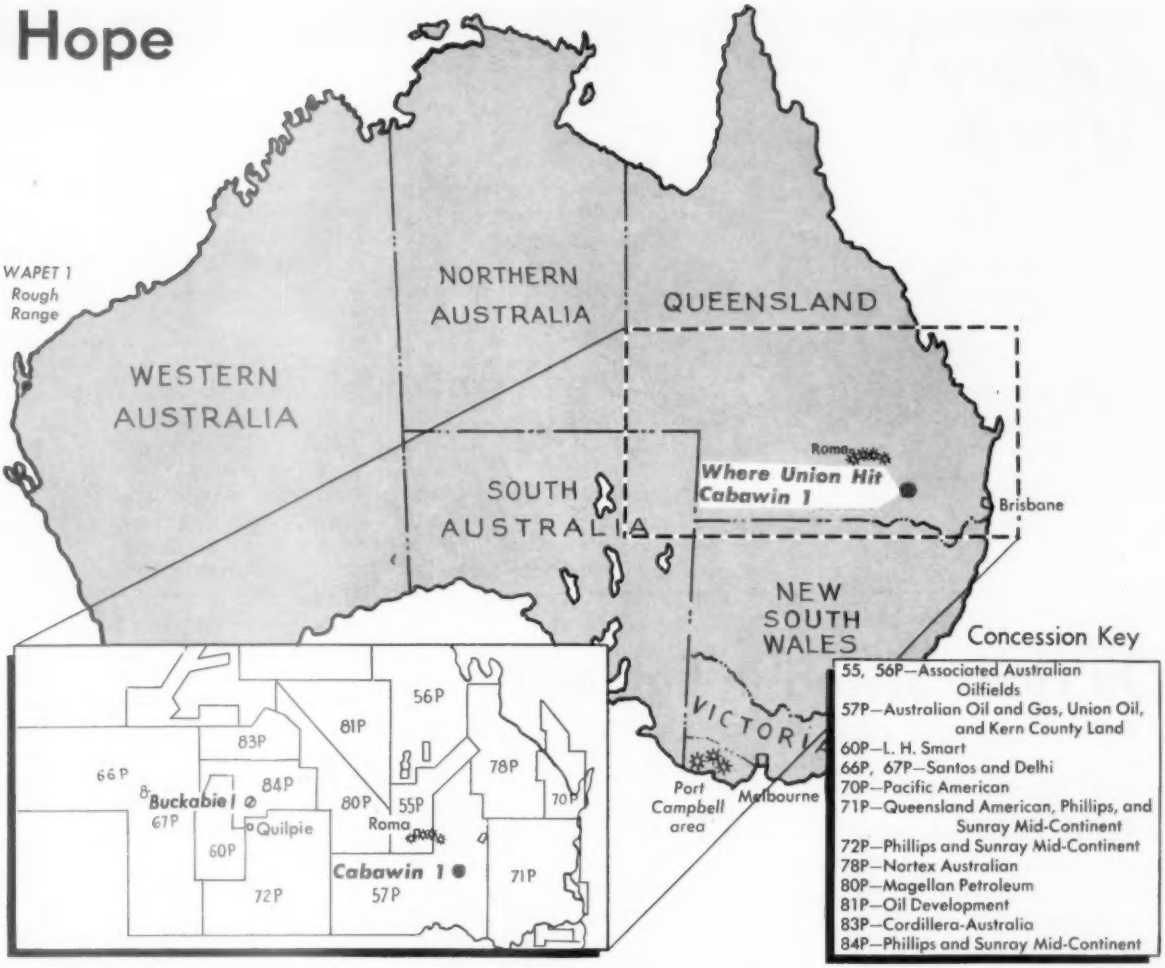
The South Australian Mines Department has been making seismic surveys in a program designed to follow the Cambrian strata beneath the Great Artesian basin from their widespread outcrops in western Queensland. There is a possibility that deep marine Permian troughs may extend into these areas.

Other promising areas include Port Campbell in western Victoria, where a deep marine section of fossiliferous black shale has been discovered.

Papua had short-lived oil flows from Tertiary rocks in 1958 and some good gas pressures in 1959.

Australia may turn out to be a happy hunting ground for geologists. In any event, ambitious efforts to find commercial production can be expected. The country now has the biggest concentration of geologic know-how and drilling ability ever assembled during its long search for oil.

# of Hope



tralia, and by an emphasis on geological, geophysical, and seismic work before drilling.

Of 25 tests started or completed in the country last year, 20 were drilled in eastern Australia. There are now 12 seismic crews operating in the country, compared with three crews 3 years ago.

Other shows . . . Until Cabawin, one of the most promising indications of hydrocarbons was Pickanjinnie 1, about 100 miles northwest of the Union Oil well.

Drilled by Associated Australian Oilfields, Pickanjinnie, near Roma, tested a total of more than 6,000 M.c.f. daily from two sands through a 1-in. choke. The first pay was encountered at 4,007 ft.

Pickanjinnie and three other gas wells at Roma produce from the Triassic.

Reportedly, the formation from which the Cabawin 1 is producing is Permian, a much older zone.

A small gas field also was tapped on the southern coast of Australia in Victoria Province, where Frome-Broken Hill initially tested 4 million cu. ft. daily in Port Campbell 1.

Three wells have been drilled at Port Campbell and the structure has been definitely classed as non-commercial. Seismic work is now in progress in the vicinity, and a new test will be started soon about 5 miles from Port Campbell 3.

WAPET has temporarily suspended its drilling operations in western Australia because of the rainy season.

Water Prevents Test of Timor Show

A WILDCAT on the island of Timor had a "substantial" show of oil at a shallow depth, but a strong flow of water prevented the operator from testing the zone.

The show was reported in the 1 Matai, which was drilled on the southern coast near the center of the island.

Light paraffinic oil shows were found from 800 ft. down to 1,100 ft.

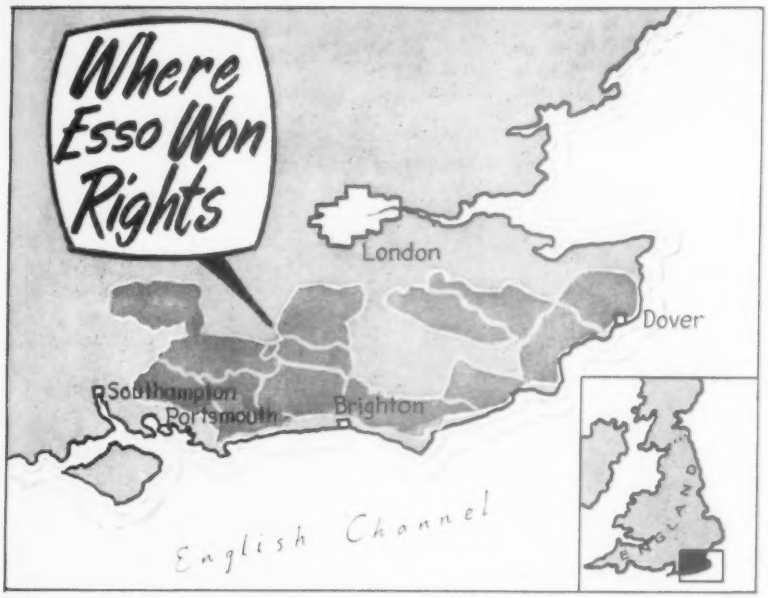
The operator drilled ahead toward a target depth of about 5,500 ft. in the Triassic, with plans to come up the hole and test the shallow zone. However, the bit hit a water zone at 2,027 ft. that forced abandonment.

A whipstock was set at 500 ft. and the well was redrilled to 1,100 ft. in an effort to test the prospective zone.

But the strong flow of water from the original hole prevented a test.

Water flow reached 1,000 bbl. daily.

Morton A. Sterlin, president of Sunset International Petroleum Corp., Beverly Hills, Calif., says the rig will be skidded about 200 ft. and a second well drilled. The 2 Matai will go to 1,600 to 1,800 ft.



Oil Hunt Slated in England

PROSPECTING LICENSES covering 1,349,760 acres in southeastern England have been awarded to Esso Petroleum Co.

The rights on 13 individual licensing areas were sought because of geological similarity to the productive Paris basin in France.

A drilling program will depend on the results of a planned seismic survey.

British Petroleum last year had an oil show in Dorset, a coastal area to the west. But most of the 1,700 bbl. daily produced in England is from small fields in the midlands.

Yugoslavia Aims at 100% Crude Rise

YUGOSLAVIA plans to more than double its crude production to 44,000 bbl. daily by 1965.

The government is optimistic about meeting this target on the basis of recent production gains and new discoveries. Output last year rose 46% from the 11,500-bbl.-daily level achieved in 1959.

The country's immediate goal is an output of 22,000 bbl. daily this year. This level was met as early as January and February, when output averaged 21,200 and 22,200 bbl. daily.

Last year's discoveries included two fields in Croatia—in the Ferdinandovac and Lipovljana areas. Four finds were made in Serbia—at Kikinda, Elemir, Boka, and Konak.

The Kikinda field eventually may produce 20,000 bbl. daily. Along with Struzec field, it may become one of the mainstays of Yugoslavia's crude supply (OGJ, March 20, p. 87).

New reserves also have been discovered in the Lendava area, which has been in a state of decline. A discovery at 3,900 ft. has been made at Paklenice in this area, and a deep pay in Petisevci field has been found at 9,700 ft.

Yugoslavia will increase its refining capacity to keep in step with its crude-production plans.

The 10,000-bbl. "Boris Kidric" refinery, located on the Adriatic Coast near Rijeka, will be expanded to 20,000 bbl. daily in 4 years.

This is the second plant construction program disclosed by Naftaplin, the state oil agency. Construction is starting on a new 24,000-bbl. refinery near Pancevo, 10 miles from Belgrade on the east side of the Danube.

BP Starts

- Company chief denies nationalist charges of greed, discrimination.

THE HEAD of one of the world's biggest oil producers last week chided the nationalists in middle eastern producing countries who complain they do not get a fair share of oil profits.

He also took sharp issue with the claim that the international oil business is domniated by 7 or 8 large companies who belong to an exclusive "club" which will not accept any new members.

Maurice Bridgeman, chairman of British Petroleum Co., which controls more oil production in the Middle East than any other single company, countered the two most prevalent Middle East complaints in the annual report to his stockholders.

His comments, couched in diplomatic language, amount to a typically British understatement.

He cited his own company's figures for 1960 and used the occasion to rebut the two most persistent nationalist themes in the Middle East.

Few, if any, other companies faced with the same type of almost ceaseless onslaught from the Arab nations have countered the Middle East claims with facts and profit figures.

Speaking specifically for BP, but generally for the entire oil industry, Bridgeman said:

... **The 50-50 profit** agreement can't be called a bad bargain for the Middle East because the industry not only accepts all the risks but must also furnish the capital needed for refining, moving, and marketing the oil.

... **Middle eastern** countries last year received five times as much money from producing operations as BP stockholders will get from the 1960 profits.

... **Borrowed money** kept BP operating in the Middle East last year because it was not able to retain enough out of earnings to meet capital expenditure needs and still maintain the working capital it needed.

Talking Tough to Middle East Critics

BP's Bridgeman
. . . diplomatic, but tart.

Bridgeman pointed out that BP is "in no way unique" in this respect.

. . . Reasonable and reasonably stable prices for oil are essential to BP and the industry. Bridgeman said if oil prices fall this simply means that the industry will have to borrow a bigger share of its operating capital from the money markets.

. . . Competition between the large international companies, and the independents, plus technical progress has built the industry.

The big companies have gotten big by "charging reasonable prices to consumers, and by paying a fair rent to the landlord, rather than taking advantage of short-term opportunities."

BP and 50-50 . . . British Petroleum owns half the prolific production in little Kuwait, has a 40% interest in the Iranian producing operation, and slightly less than 24% of the oil produced in Iraq and Qatar.

Payments to the middle eastern countries under the 50-50 agreements are based on posted prices and the total sum included in BP's 1960 accounts for such payments was $359,400,000.

The BP chairman contrasted this with $174,000,000 in BP profits last year. Profits, he said, are the result of all operations, not just production.

He said the 1960 payments to Middle East governments were greater than those for 1959 in spite of the fact that posted prices for crude oil were reduced last August.

"The explanation is, of course, that a greater volume of oil was lifted and this more than counteracted the effects of the lower posted prices," Bridgeman said.

The BP chairman then charted the differences between what is done with the 50% which goes to the "landlord" Middle East government.

In order to "bring to consumers the ever greater quantities" of oil, the company has to pay for production facilities, tankers, pipelines, refineries, and marketing installations. He points out that these all cost money and are all just as important to the host country—if they want to increase income. But only the company pays the bill.

The host countries, Bridgeman points out, are free to direct their revenue toward projects vital to their economic development but for which private capital is not so readily available.

To prove that BP's share of the producing income doesn't quite stretch far enough he cited the fact that his company spent $1,176,000,000 for capital expenditures and working capital in the 1958-60 period. During the same 3-year period, the BP group retained money from annual profits totaling only $823,200,000.

The gap between the two had to be borrowed.

Bridgeman conceded to his stockholders that BP group sales and volume of crude and products were at all time highs in 1960, but net income dipped below 1959 because of an increase in taxes.

The 1960 sales were $2,623,737,000 compared with $2,374,769,000 in 1959. Crude oil and refined product volume reached 547,000,000 bbl. last year, an increase of 15% over 1959. Net income was $168.9 million compared with $174 million in 1959.

Iranian Wildcats Spudded

TWO NEW wildcats have been spudded by Iranian Oil Exploration & Producing Co., one of the two operating companies for the Consortium group.

One of the tests is on Sheikh Shoeib Island in the Persian Gulf. South Eastern Drilling Co. is the contractor.

The other well is a deep test at Gachsaran.

This is projected to 10,000 ft. in an investigation of the Cretaceous and lower formations below the Asmari limestone producing zone. Santa Fe Drilling Co. is the contractor.

Blowout, Fire Put Crimp in Khafji Work

ANOTHER BLOWOUT and fire in Khafji oil field in the Persian Gulf off the Neutral Zone has temporarily interrupted some of Arabian Oil Co.'s development operations.

A platform and derrick on a well in the northern part of the field were completely destroyed. The tender, however, was cut loose and apparently was saved.

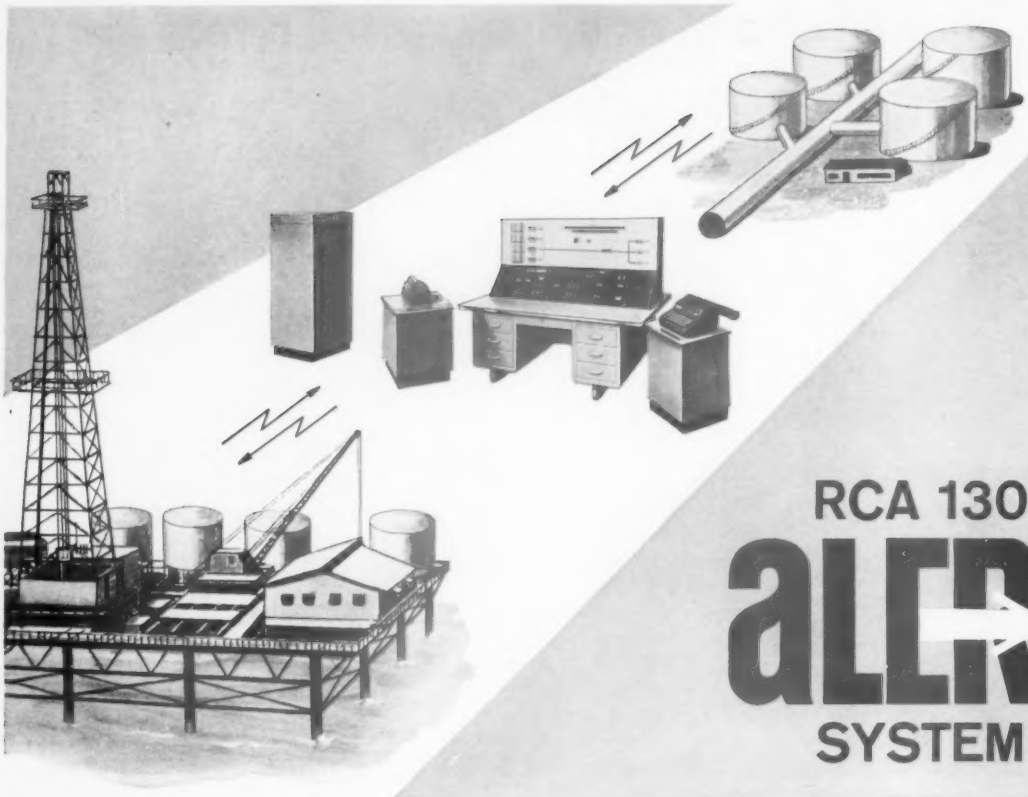
Southeastern Drilling, Dallas, is the contractor on the well.

The blowout in the Japanese-controlled field occurred when the well encountered what is probably the same high-pressure sulfurous-gas zone that caused trouble in the Khafji 1 discovery in July 1959. The gas sand is at 1,500 ft.

The first blowout burned for 9 days. Drilling operations were suspended for 4 months.

Thirteen out of thirteen wells have been completed as producers in the 4,000-to-6,000 bbl.-daily class at Khafji.

The first shipment of crude to Japan has been made from temporary offshore loading facilities. A 200,000-bbl.-daily terminal is being built onshore.



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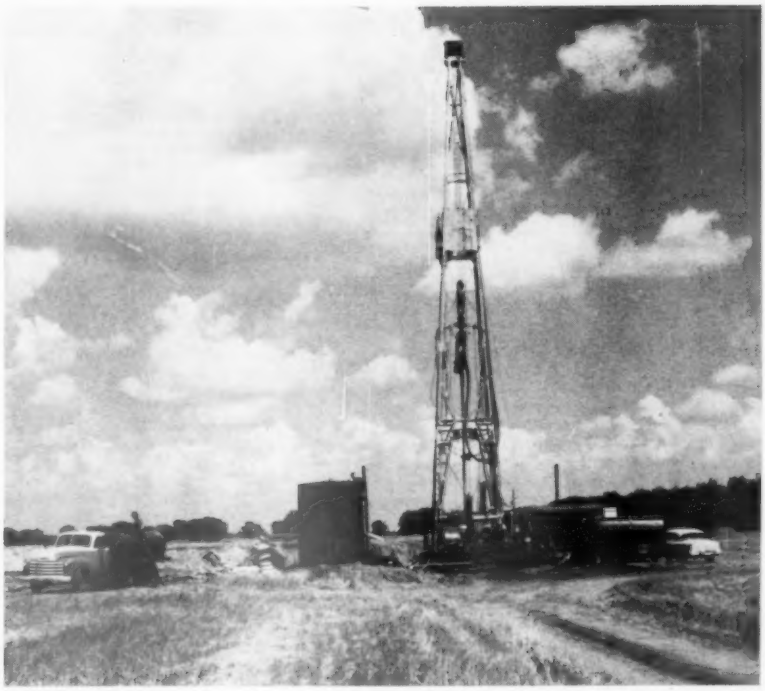
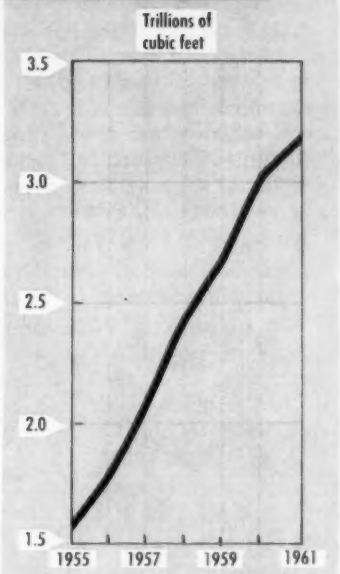


A PIONEER in gas storage, Cities Service Gas Co. has completed its ninth facility in Kansas. This is one of 12 wells drilled to the Misener gas formation in a $2,000,000 program at the new Alden storage field. Alden has total reservoir capacity of 14,773,000 M.c.f. Cities Service Gas put its first storage field in operation back in 1929.

Total Storage Capacity to Hit 3.2 Trillion Cubic Feet



Gas-storage capacity climbs . . .

but the rate of growth is slowing

• New projects under way or testing to hike capacity to 3.056 trillion cubic feet. Additional planned facilities will push it to 3.198 trillion, for a 5.7% gain over last year. Big increase due in Canada.

BY ROBERT B. BIZAL
Director Editorial Research

DEVELOPMENT of new underground storage capacity for natural gas is still popular, but the rate of growth has slowed down a bit in the U. S.

The Journal's seventh annual survey of 59 companies indicates that total reservoir capacity will climb to 3.198 trillion cubic feet when projects now under way, testing, or planned are completed.

This is a healthy gain of 5.7% over the previous year, but falls short of the average annual increase of 13.6% for the 1955-60 period. In volume, as well as percentage, the increase this year has been smaller than any other year since 1955.

But most signs point to continued growth in the natural-gas industry, and undoubtedly development of new storage areas will not hit a plateau for some time.

Natural-gas reserve figures and consumption made good gains last year, and important new pipelines are being built. So it's very likely that the industry will continue to plan ahead for peak seasonal demands of millions of customers and for stabilization of year-round pipeline load factors.

The picture is different in Canada. Development of storage capacity just now seems to be getting off the ground—but in a big way.

Of the 16 facilities reported, about half are under way or planned. They will increase capacity considerably in the populous eastern part of the country.

R. P. Charbonnier of the Canadian Department of Mines and Technical Surveys says that with the

completion of the Trans-Canada gas line from the west to the east several years ago, "the consumption of natural gas is expected to grow very rapidly in southern Ontario and Quebec, in a trend similar to that which occurred in the eastern U. S. in recent years."

"U. S. data show the importance of underground storage as a solution to irregular consumption problems and winter peak demand periods, and the situation in Canada is likely to be very similar," he said.

The U. S. Picture

Of the 221 U. S. facilities and projects in 23 states, more than 25 are under way, testing, or planned.

Not counting those projects which are merely in the planning stage, total U. S. reservoir capacity for facilities actually in existence, under way, or testing amounts to 3.056 trillion cubic feet.

This compares with about 2.888 trillion cubic feet in that category last year—or a gain of about 5.8%.

This total reservoir capacity breaks down into an estimated working-gas capacity of 1.557 trillion, with required cushion gas at about 1.5 trillion.

Most of the big storage fields are near the big consumer areas in the Midwest and eastern states.

But storage is by no means confined to those areas. The West Coast has one of the world's largest under development, and a new state, Utah, has been added to the list.

Nature, which provided the gas in the first place, is doing double duty, since most of the storage capacity is in depleted gas fields.

But since gas sands are not always conveniently located near big consuming areas, some facilities have been developed in aquifers, and one project is under way in an abandoned coal mine in Colorado.

This quest for new ways to store gas underground has led Northern Illinois Gas Co. to test a "bubble storage" theory in which gas would be trapped and held in other than dome-shaped structures.

Under this theory, gas would be trapped under flat cap rock by injecting a wall of water on the open side of the rock formation or on the periphery of the reservoir (OGJ June 13, 1960, p. 76).

Natural-Gas Underground-Storag

All figures in M.c.f.

Company Field or area — County	Working-gas capacity	Required as cushion gas	Total capacity of reservoir
Arkansas			
Arkansas Western Gas Co.			
Carrollton Dome—Boone (experimental)*	8,000,000	2,000,000	10,000,000
Stephens Production Co.			
Lavaca—Sebastian	1,004,550	3,013,624	4,018,174
Shibley—Crawford	419,920	766,327	1,186,247
Total	9,424,470	5,779,951	15,204,421
*Figures estimated.			
California			
Pacific Gas & Electric Co.			
McDonald Island—San Joaquin (under development)	*124,500,000	54,000,000	178,500,000
Pleasant Creek—Yolo (under development)	3,250,000	5,078,500	8,328,500
Pacific Lighting Gas Supply Co.			
East Whittier—Los Angeles	800,000	425,000	1,225,000
Goleta—Santa Barbara	12,500,000	32,181,544	44,681,544
Montebello—Los Angeles	12,500,000	26,000,000	38,500,000
Southern California Gas Co.			
Playa del Rey—Los Angeles	4,000,000	1,000,000	5,000,000
Total	157,550,000	118,685,044	276,235,044
*This includes 30,000,000 M.c.f. storage capacity and 94,500,000 M.c.f. of unused reservoir capacity.			
Colorado			
Public Service Co. of Colorado			
Leyden coal mine—Jefferson (under way)	2,000,000	1,000,000	3,000,000
Illinois			
Illinois Power Co.			
Freeburg—St. Clair	1,810,000	4,590,000	6,400,000
Gillespie—Macoupin	31,000	115,000	146,000
North Tilden—Washington and St. Clair (nearing completion)			2,600,000
Mississippi River Fuel Corp.			
St. Jacob (proposed)			*(32,000,000)
Waterloo—Monroe (experimental)	†100,000		
Natural Gas Storage of Illinois			
Cooks Mills—Coles	901,264	993,736	1,895,000
Herscher, Galesville aquifer—Kankakee	45,000,000	45,000,000	90,000,000
Herscher, Mt. Simon reservoir—Kankakee (under way)	39,000,000	28,000,000	67,000,000
Mahomet—Champaign (testing)			
Northern Illinois Gas Co.			
Crescent City—Iroquois (planned)			
Troy Grove—LaSalle	16,000,000	8,000,000	24,000,000
Various counties in northern Illinois (high-pressure pipe)			184,700
Panhandle Eastern Pipe Line Co.			
Waverly (under development)			
Total (planned)			(32,000,000)
Total (existing, under way, or testing)	102,842,264	86,698,736	192,225,700
Grand total			224,225,700
*Geologists' estimate for fully developed field. Not yet approved by FPC. †Being used in limited state. Still considered experimental.			
Indiana			
Central Indiana Gas Co.			
Randolph County (under way)			
Citizens Gas & Coke Utility			
Howesville—Greene	2,000,000	2,000,000	4,000,000
Indiana Gas & Water Co.			
Greensburg—Decatur	400,000	600,000	1,000,000
Unionville—Monroe	1,500,000	1,000,000	2,500,000
Westpoint—Tippecanoe	250,000	350,000	600,000
Southern Indiana Gas & Electric Co.			
Oliver—Posey	1,148,500	1,750,500	2,900,000
Texas Gas Transmission Corp.			
Alford—Pike	969,300	1,500,000	2,469,300

Capacity in the United States

Company Field or area County	All figures in M.c.f. Working-gas capacity	Required as cushion gas	Total capacity of reservoir
Leesville—Lawrence (experimental)			
Oaktown—Knox	610,710	420,490	1,031,200
Wilfred—Sullivan	1,200,000	1,200,000	2,400,000
Total	8,078,510	8,820,990	16,900,500
Iowa			
Northern Natural Gas Co.			
Redfield—Dallas (ultimate planned for St. Peter aquifer)	15,000,000	25,000,000	40,000,000
Redfield—Dallas (estimated ultimate for Mount Simon aquifer)*	30,000,000	70,000,000	100,000,000
Total	45,000,000	95,000,000	140,000,000
*Operated on a testing permit issued by FPC.			
Kansas			
Arkansas Louisiana Gas Corp. (formerly Consolidated Gas Utilities Corp.)			
Collinson—Cowley	674,270	425,730	1,100,000
Cities Service Gas Co.			
Alden—Rice (recently completed)	5,000,000	9,773,582	14,773,582
Boyer—Butler	392,279	627,588	1,019,867
Colony—Anderson	4,148,104	5,055,561	9,203,665
Craig—Johnson	1,557,945	4,517,875	6,075,820
Elk City—Montgomery and Elk	10,000,000	10,000,000	20,000,000
McLouth—Jefferson and Leavenworth	5,212,337	7,701,420	12,913,757
North Welda—Anderson	4,521,646	5,500,000	10,021,646
Piqua—Allen and Woodson	1,551,042	1,679,430	3,230,472
South Welda—Anderson	5,313,617	6,475,569	11,789,186
Union Gas System, Inc.			
Five fields in Wilson, Montgomery, and Chautauqua counties	3,034,023	3,908,194	8,250,000
Total	41,405,263	55,664,949	98,377,995
Kentucky			
Kentucky Gas Transmission Corp.			
Menifee—Menifee, Powell	1,200,000	6,542,480	7,742,480
Louisville Gas & Electric Co.			
Doe Run—Meade, Ky., and Harrison, Ind.	3,100,000	1,200,000	4,300,000
Magnolia—Hart, Green, and Larue	3,000,000	1,000,000	4,000,000
Muldraugh—Meade	2,100,000	200,000	2,300,000
Texas Gas Transmission Corp.			
Dixie—Henderson	2,524,500	4,590,000	7,114,500
Western Kentucky Gas Co.			
Grandview—Daviess*	254,000	358,000	612,000
Hickory School—Daviess*	433,000	567,000	1,000,000
Judge Chapel—Christian†			520,000
Kirkwood Springs—Hopkins	225,000	300,000	525,000
Owensboro—Daviess	31,000	25,000	56,000
Total	12,867,500	14,782,480	28,169,980
*Purchased from Texas Gas Transmission Corp. †Scheduled for operation winter 1962-63.			
Maryland			
Washington Gas Light Co.			
Brandywine—Prince Georges (planned)			(30,000,000)
Michigan			
Consumers Power Co.			
Northville—Wayne*	8,000,000	22,200,000	30,200,000
Overisel—Allegan (formerly Michigan Gas Storage Co. facility)	20,000,000	47,000,000	67,000,000
Salem—Allegan*	18,000,000	39,200,000	57,200,000
Michigan Consolidated Gas Co.			
Austin—Mecosta	7,600,000	10,319,200	17,919,200
Goodwell—Newaygo	10,900,000	8,922,208	19,822,208
Lincoln-Freeman—Clare	14,700,000	9,577,849	24,277,849

Current U. S. Projects

Here is a rundown of some of the projects recently completed, under way, testing, or planned. (For more detail, see accompanying table.)

... **Atlantic Seaboard Corp.** has completed its Terra Alta (X-76) storage field in Preston County, West Virginia. Total capacity is 45,800,000 M.c.f., with working gas at 15,600,000.

... **Cities Service Gas Co.** recently completed its Alden storage project in Kansas and is starting full-scale injection this spring. Total capacity of 14,773,000 M.c.f. includes 5,000,000 working gas. The project, including gathering lines and a new compressor engine, brings total cost to nearly $2,000,000.

... **Citizens Gas & Coke Utility** will begin initial gas-storage injection at Howesville field, Indiana, the latter part of 1961. Withdrawals of limited quantities may be made during the 1961-62 winter season.

... **East Ohio Gas Co.** drilled 35 new wells at long-established Stark-Summit field in Ohio in 1960 and plans to drill another 35 wells in 1961. The drilling program will be completed by the end of 1964. This is one of the nation's largest reservoirs with capacity of 118,000,000 M.c.f., including working gas of about half this amount.

... **Illinois Power Co.** will complete new facilities at North Tilden field, Illinois, June 15, 1961. Total reservoir capacity is 2,600,000 M.c.f.

... **Laclede Gas Co.** has suspended testing at Columbia in Boone County, Missouri, and is developing a second formation, the Robidoux, at its Florissant storage field in St. Louis County. Robidoux capacity would be an estimated 20,000,000 M.c.f. Capacity of the St. Peter formation at Florissant is 40,000,000 M.c.f.

... **Louisville Gas & Electric Co.,** which has three facilities in Kentucky, is investigating possibility of storage in a deeper geological stratum under an existing field. Feasibility will not be known until late 1961 or 1962.

... **Manufacturers Light & Heat Co.** is adding facilities at Victory field, West Virginia. Completion is set for 1962 when the project will be filled to capacity. Reservoir ca-

pacity is 30,700,000 M.c.f., with working-gas capacity of 11,700,000 M.c.f.

...Mississippi River Fuel Corp. is awaiting FPC approval for its St. Jacob, Ill., project, which would have capacity of 32,000,000 M.c.f. when fully developed. The company is also continuing experiments at Waterloo field. The latter is now being used in a limited state.

...Mountain Fuel Supply Co. is experimenting with displacement of water with gas in the Chalk Creek structure near Coalville, Utah. The company says that storage here would be "of considerable importance in meeting the winter peak demand." This would be the first for Utah.

...Natural Gas Storage Co. of Illinois, a subsidiary of Peoples Gas Light & Coke Co., is testing at Mahomet, Ill. At the company's Cooks Mills and Herscher storage areas, new facilities are being built to increase the maximum daily withdrawal by 75,000 M.c.f. to a total of 725,000.

...Northern Illinois Gas Co. is expanding at Troy Grove, Ill., with total reservoir capacity to be doubled to 24,000,000 M.c.f. Two rigs are now being used to drill 21 wells. Testing will probably take at least a year. Existing Troy Grove facilities, the company's share of Herscher facilities near Kankakee, and additional pipeline supplies permitted the company to lift all space-heat restrictions last winter for the first time since 1946.

Another northern Illinois project is planned for the Crescent City aquifer in Iroquois County, pending approval of the Illinois Commerce Commission. Preliminary development is set for completion by 1963.

...Northern Natural Gas Co. has asked the FPC to allow gas injection to a total of 60,000,00 M.c.f. reservoir inventory in the Mt. Simon formation at Redfield, Iowa. Present allowable is 45,000,000. The FPC request also seeks withdrawals of 95,000 M.c.f. daily for the 1961-62 heating season.

...Pacific Gas & Electric Co. is developing the world's largest storage reservoir in the world at McDonald Island field, California. This will enhance the high-load-factor operation of the new Alberta-to-San Francisco gas line (OGJ, Mar. 13, p. 110).

Natural-Gas Underground-Storage

Company Field or area — County	All figures in M.c.f. Working-gas capacity	Required as cushion gas	Total capacity of reservoir
Reed City—Osceola	11,300,000	10,587,100	21,887,100
Six Lakes—Mecosta and Montcalm	53,300,000	14,020,614	67,320,614
Michigan Gas Storage Co.			
Cranberry Lake—Clare	8,275,710	19,624,050	27,909,760
Riverside—Missaukee	3,132,530	7,419,150	10,551,680
Winterfield—Clare	20,425,000	48,375,000	68,800,000
Panhandle Eastern Pipe Line Co.			
Howell—Livingston (planned)			(20,000,000)
Total (planned)			(20,000,000)
Total (existing, under way, or testing)	175,633,240	237,245,171	412,888,411
Grand total			432,888,411

*This field in process of procurement.

Mississippi

Mississippi Valley Gas Co.			
Amory—Monroe	781,874	318,126	1,100,656
United Gas Pipe Line Co.			
Jackson—Rankin and Hinds	4,100,000	900,000	5,000,000
Total	4,881,874	1,218,126	6,100,656

Missouri

Laclede Gas Co.			
Florissant, Robidoux formation—St. Louis (new project)	10,000,000	10,000,000	20,000,000
Florissant (St. Peter formation)—St. Louis	20,000,000	20,000,000	40,000,000
Total	30,000,000	30,000,000	60,000,000

Montana

Montana-Dakota Utilities Co.			
Baker—Fallon	64,082,000	16,018,000	80,100,000
Montana Power Co.			
Box Elder—Hill	397,000	2,043,000	2,440,000
Madison aquifer—Gallatin	1,000,000	5,000,000	6,000,000
Shelby—Toole	279,000	2,021,000	2,300,000
Total	65,758,000	25,082,000	90,840,000

New Mexico

El Paso Natural Gas Co.			
Rhodes—Lea	35,000,000	17,400,000	52,400,000
Southern Union Gas Co.			
Barker Dakota—San Juan	8,404,135	11,480,000	19,884,135
Keyes—Eddy	875,183	930,000	1,805,183
Vandagriff—Eddy	630,682	2,480,000	3,110,682
Total	44,910,000	32,290,000	77,200,000

New York

Home Gas Co.			
Dundee—Schuyler, Steuben, and Yates	4,500,000	6,000,000	10,500,000
Gilbert—Allegany	225,000	325,000	550,000
Greenwood—Steuben	1,050,000	950,000	2,000,000
Iroquois Gas Corp.			
Bennington—Wyoming	2,500,000	1,500,000	4,000,000
Collins—Erie	1,600,000	1,000,000	2,600,000
Derby—Erie	200,000		200,000
Holland—Erie	1,200,000	1,000,000	2,200,000
Lawtons—Erie	1,100,000	1,000,000	2,100,000
Nashville—Erie, Chautauqua, and Cattaraugus	4,400,000	3,600,000	8,000,000
Sheridan—Chautauqua	1,000,000	1,000,000	2,000,000
Zoar—Erie	1,000,000	1,000,000	2,000,000
New York State Natural Gas Corp.			
Woodhull—Steuben	21,120,000	14,080,000	35,200,000
Sylvania Corp.			
Tuscarora—Steuben	2,700,000	2,500,000	5,200,000
Tennessee Gas Pipeline Co. and Iroquois			
Colden—Erie	10,000,000	10,000,000	20,000,000
Total	52,595,000	43,955,000	96,550,000

Capacity in the United States

Company Field or area County	All figures in M.c.f. Working-gas capacity	Required as cushion gas	Total capacity of reservoir
Ohio			
East Ohio Gas Co.			
Chippewa—Wayne	4,117,623	4,117,623	8,235,247
Columbiana—Columbiana	1,524,900	1,524,900	3,049,800
Stark-Summit—Stark and Summit	59,032,373	59,032,373	118,064,746
Manufacturers Light & Heat Co.			
Brinker—Columbiana	3,300,000	3,700,000	7,000,000
Ohio Fuel Gas Co.*			
Benton—Hocking	.....	.....	39,500,000
Guernsey—Guernsey and Coshocton	.....	.....	5,500,000
Holmes—Holmes and Wayne	.....	.....	26,000,000
Knox—Knox	.....	.....	3,700,000
McArthur—Vinton	.....	.....	10,500,000
Medina—Medina	.....	.....	8,500,000
Pavonia—Ashland	.....	.....	39,000,000
Weaver—Ashland and Richland	.....	.....	72,500,000
Wellington—Lorain and Medina	.....	.....	21,800,000
Zane—Muskingum	.....	.....	80,000
Total	.....	.....	363,429,793
*Working and cushion gas figures not reported.			
Oklahoma			
Arkansas Louisiana Gas Co. (formerly Consolidated Gas Utilities Corp.)			
Ulan—Pittsburg	7,495,174	6,004,826	13,500,000
Oklahoma Natural Gas Co.			
Depew—Creek	19,600,000	37,400,000	57,000,000
Haskell—Muskogee	2,500,000	8,400,000	10,900,000
Osage—Osage	830,000	1,900,000	2,730,000
Sayre—Beckham	63,500,000	25,800,000	89,300,000
Southwest Natural Gas Co.			
North Ada—Pontotoc	6,000,000	4,000,000	10,000,000
Total	99,925,174	83,504,826	183,430,000
Pennsylvania			
Equitable Gas Co.			
Seven pools in Allegheny, Washington, and Greene counties	15,336,000	4,974,000	20,310,000
Manufacturers Light & Heat Co.			
Cross Creek—Washington (being depleted)	100,000	800,000	900,000
Donegal—Washington	3,400,000	4,000,000	7,400,000
Heard—Greene, Washington	3,500,000	6,000,000	9,500,000
Holbrook—Greene	600,000	600,000	1,200,000
Iowa—Jefferson	125,000	175,000	300,000
Irwin—Westmoreland	25,000	250,000	275,000
Majorsville—Greene and Washington, Pa., and Marshall, W. Va.	10,000,000	19,500,000	29,500,000
Munderf—Jefferson	50,000	.....	50,000
New York State Natural Gas Corp.			
Sabinsville—Tioga	15,450,000	18,000,000	33,450,000
Sharon—Potter	1,900,000	4,200,000	6,100,000
South Bend—Armstrong and Indiana counties	6,600,000	10,500,000	17,100,000
Tioga—Tioga	8,000,000	14,000,000	22,000,000
New York State Natural Gas and Tennessee Gas			
Ellisburg—Potter (under consideration)	.....	.....	.....
Harrison—Potter, Pa., and Steuben, N. Y.	19,680,000	13,120,000	32,800,000
New York State Natural Gas and Texas Eastern			
Oakford—Westmoreland	60,000,000	50,758,000	110,758,000
New York State Natural Gas, Texas Eastern, and Transcontinental Gas Pipe Line Corp.			
Leidy—Clinton and Potter*	60,000,000	45,650,000	105,650,000
North Penn Gas Co.			
Farmington—Tioga	8,200,000	1,800,000	10,000,000
Meeker—Tioga	4,800,000	200,000	5,000,000

The facility has total reservoir capacity of 178,500,000 M.c.f., including 94,500,000 unused capacity, 30,000,00 storage capacity, and 54,00,000 cushion gas. Maximum withdrawal when the field is full will be 400,000 M.c.f. daily. Filling is being delayed until completion of the big line for the 1961-62 heating season.

... **Panhandle Eastern Pipe Line Co.** has asked FPC for permit to develop Howell field, Livingston County, Michigan. Total capacity will be 20,000,000 M.c.f., of which 3,500,000 would be working gas. Facilities involved in the project would cost more than $4,700,000. The request calls for initial delivery capability of 25,000 M.c.f. daily.

Still pending FPC approval is the proposed storage at Waverly, Ill. Testing has been under way for several years.

... **Public Service Co. of Colorado** expects to use its unique Leyden coal-mine storage facility in Colorado during the 1961-62 winter, making available up to 40,000 M.c.f. daily.

Initial testing of this abandoned mine began in 1959. Test gas is now being withdrawn to enable completion of the sealing of four shafts. The cavern will then be refilled and additional compressors installed this summer. Total estimated reservoir capacity is 3,000,000 M.c.f., of which two-thirds is working gas.

... **Western Kentucky Gas Co.** plans to put its Judge Chapel field in Kentucky in operation in 1962-63. Capacity will be 520,000 M.c.f.

The status of several other projects remain about the same as last year, including: Arkansas Western Gas Co., Boone County, Arkansas, experimenting; Central Indiana Gas Co., Randolph County, Indiana, studying geological data; Equitable Gas Co., Rhodes pool, West Virginia, development under way; Pleasant Valley Gas & Oil Co., Lewis County, Washington, planned; Tennessee Gas Pipeline Co. and New York State Natural Gas Corp., Ellisburg field, Pennsylvania, under consideration; Texas Gas Transmission Corp., Lawrence County, Indiana, experimental; and Washington Gas Light Co., Brandywine, Md., planned.

For the latter, a bill of eminent domain died in the Maryland legis-

lature, and the session ended in April.

Growing Canadian Interest

Companies are showing a great deal of interest in the possibility of additional storage in Canada.

Three provinces use such facilities—Ontario in the populous east and Alberta and Saskatchewan in the gas-producing west.

Total reservoir capacity, including existing facilities and those under development, comes to 120,849,000 M.c.f. Another 88,635,000 M.c.f. is planned in Ontario which will give the nation a total of 209,484,000 M.c.f. (See accompanying table for details.)

Storage in "southwestern" Ontario is concentrated in old gas fields in Lambton County. Southwestern Ontario is the populous southernmost part of Canada where such cities as Sarnia and Windsor are located.

In March, the Ontario Energy Board held a hearing on an application by Imperial Oil Ltd. for regulations designating five pools in this area.

Partially depleted gas fields would be used to store Alberta gas, pumped through the Trans-Canada line, for winter use in the eastern markets (OGJ Newsletter Feb. 6).

Union Gas Co. of Canada and its subsidiary Ontario Natural Gas Storage & Pipelines, Ltd., Chatham, have four existing storage areas in Lambton County, and two more under way.

In the western part of the nation, Canadian Western Natural Gas Co.'s Bow Island field in Alberta was one of the first storage developments ever attempted.

Construction started in the spring of 1929. At present 1,800,000 M.c.f. is stored during summer months and withdrawn during peak winter days.

But storage in the eastern part of Canada is of more concern than in the west.

A circular published by the Canadian Department of Mines and Technical Surveys points out that "at present there are no partly depleted gas or oil fields that could be used for gas storage in southeastern Ontario (adjacent to Quebec) and the St. Lawrence lowlands of Quebec.

Natural-Gas Underground-Storage

Company Field or area — County	All figures in M.c.f. Working-gas capacity	Required as cushion gas	Total capacity of reservoir
Pennsylvania Gas Co.			
Total for nine fields	9,850,000	7,400,000	17,250,000
Peoples Natural Gas Co.			
Colvin—Washington	800,000	1,500,000	2,300,000
Gamble-Hayden—Allegheny	1,100,000	1,200,000	2,300,000
Mt. Royal—Allegheny	225,000	275,000	500,000
Murrysville—Allegheny	1,500,000	1,600,000	3,100,000
Patton—Westmoreland	75,000	75,000	150,000
Truittsburg—Clarion	2,100,000	1,500,000	3,600,000
Webster—Westmoreland	540,000	600,000	1,140,000
United Natural Gas Co.			
Ten fields in eight counties	4,170,000	4,600,000	8,770,000
United Natural and Pennsylvania Gas Co.			
Keeler—McKean†	600,000	1,200,000	1,800,000
United Natural and Tennessee Gas			
Hebron—Potter	22,500,000	23,800,000	46,300,000
Total	261,226,000	238,277,000	499,503,000
Texas			
Houston Pipe Line Co.			
Bammel—Harris (option at cycling project)			2,000,000
Lone Star Gas Co.			
Ambassador—Clay	1,170,000	530,000	1,700,000
Leeray—Stephens	5,250,000	2,175,000	7,425,000
New York City pool—Clay	4,600,000	1,825,000	6,425,000
Tri-Cities—Henderson	25,575,000	8,125,000	33,700,000
View—Taylor	2,630,000	1,120,000	3,750,000
Southwest Natural Gas Co.			
Chapman—Comanche	100,000	100,000	200,000
Lester—Comanche	3,500,000	2,000,000	5,500,000
Total	42,825,000	15,875,000	60,700,000
Utah			
Mountain Fuel Supply Co.			
Coalville area—Summit (experimenting with aquifer)			
Washington			
Pleasant Valley Gas & Oil Co.			
Jackson Prairie—Lewis (under study)			(60,000,000)
West Virginia			
Atlantic Seaboard Corp.			
X-56—Upshur	2,900,000	6,700,000	9,600,000
X-76—Preston	15,600,000	30,200,000	45,800,000
Cabot Corp.			
Fayette Land Co.—Fayette	18,000	14,000	32,000
Heizer X-1—Putnam	2,100,000	1,500,000	3,600,000
Raleigh—Raleigh	900,000	600,000	1,500,000
Equitable Gas Co.			
Six pools in Taylor, Doddridge, Lewis, and Marion counties	10,709,000	2,096,000	12,805,000
Rhodes—Lewis (under way)			10,000,000
Hope Natural Gas Co.			
Bridgeport—Harrison and Taylor	5,000,000	4,500,000	9,500,000
Fink—Doddridge and Lewis	24,000,000	36,000,000	60,000,000
Kennedy—Harrison and Lewis	14,000,000	21,000,000	35,000,000
Newberne—Gilmer	3,500,000	1,500,000	5,000,000
Racket—Gilmer and Ritchie	2,500,000	1,500,000	4,000,000
Manufacturers Light & Heat Co.			
Victory—Marshall and Wetzel (estimated ultimate)	11,700,000	19,000,000	30,700,000
United Fuel Gas Co.*			
X-1—Putnam	135,000	465,000	600,000
X-2—Kanawha	2,500,000	2,600,000	5,100,000
X-4—Putnam	1,300,000	2,350,000	3,650,000
X-6—Kanawha	2,800,000	3,610,000	6,410,000
X-7—Kanawha	900,000	653,000	1,553,000
X-8—Kanawha	150,000	1,260,000	1,410,000
X-15A—Putnam	750,000	985,000	1,735,000

*These figures represent ultimate development. Presently, Transco and Texas Eastern each have 15,000,000 M.c.f. of working gas and a total of 30,400,000 M.c.f. cushion gas. †Figures represent only United Natural's capacities. Pennsylvania Gas figures from this storage are included in that company's listing of nine fields.

Capacity in the United States

Company Field or area County	All figures in M.c.f. Working-gas capacity	Required as cushion gas	Total capacity of reservoir
X-15B—Kanawha	1,200,000	1,695,000	2,895,000
X-17—Roane	1,200,000	1,715,000	2,915,000
X-19A—Roane	50,000	1,310,000	1,360,000
X-19B—Roane		1,795,000	1,795,000
X-49—Putnam	800,000	1,350,000	2,150,000
X-52A—Kanawha	18,600,000	26,100,000	44,700,000
X-52B—Kanawha	4,100,000	5,852,000	9,952,000
X-52C—Kanawha	7,100,000	13,000,000	20,100,000
X-53—Kanawha	50,000	19,000	69,000
X-54—Kanawha	2,100,000	3,880,000	5,980,000
X-58—Wood and Wirt	4,500,000	4,300,000	8,800,000
X-59—Jackson	12,500,000	13,000,000	25,500,000
Total	153,662,000	210,549,000	374,211,000

*Column 2 includes native cushion gas.

Wyoming

Montana-Dakota Utilities Co.			
Billy Creek—Johnson	3,227,000	573,000	3,800,000
Elk Basin—Park	51,374,000	6,226,000	57,600,000
Total	54,601,000	6,799,000	61,400,000
U. S. TOTAL (planned)			(142,000,000)
U. S. TOTAL (existing, under way or testing)	*1,556,608,458	*1,499,758,042	3,056,366,500
GRAND TOTAL	*1,628,928,058	*1,569,438,442	3,198,366,500

*These four figures are estimates, based on ratios of working gas and cushion gas to total reservoir as reported in most cases.

. . . and in Canada

Alberta

Canadian Western Natural Gas Co.			
Bow Island field	21,000,000	4,000,000	25,000,000
Northwestern Utilities, Ltd.			
Viking-Kinsella field			
Total	21,000,000	4,000,000	25,000,000

Ontario

Consumers' Gas Co.			
Sherkston			1,500,000
Imperial Oil Ltd.			
Bickford—Lambton (planned)	(13,900,000)	(6,300,000)	(20,200,000)
Corunna—Lambton (planned)	(4,523,000)	(3,162,000)	(7,685,000)
Kimball-Colinville—Lambton (planned)	(29,400,000)	(15,420,000)	(44,820,000)
Seckerton—Lambton (planned)	(8,645,000)	(4,645,000)	(13,290,000)
Sombra—Lambton (planned)	(1,810,000)	(830,000)	(2,640,000)
Waubuno—Lambton (under way in 1960)	6,098,000	3,248,000	9,346,000
Union Gas Co. of Canada, Ltd.*			
Dawn 47-49—Lambton	3,351,000	2,075,000	5,426,000
Dawn 59-85—Lambton	3,414,000	5,401,000	8,815,000
Dawn 156—Lambton (under way)	19,000,000	11,000,000	30,000,000
Dawn 167—Lambton (under way)	1,500,000	3,000,000	4,500,000
Payne—Lambton	12,435,000	7,497,000	19,932,000
Waubuno—Lambton	6,103,000	3,227,000	9,330,000
Total (planned)	(58,278,000)	(30,357,000)	(88,635,000)
Total (existing and under way)	51,901,000	35,448,000	88,849,000
Grand Total	110,179,000	65,805,000	177,484,000

*Operated by Union Gas Co. and its subsidiary Ontario Natural Gas Storage & Pipelines, Ltd.

Saskatchewan

Saskatchewan Power Corp.			
Unity field	2,000,000	5,000,000	7,000,000
CANADIAN TOTAL (planned)	(58,278,000)	(30,357,000)	(88,635,000)
CANADIAN TOTAL (existing or under way)	74,901,000	44,448,000	120,849,000
GRAND TOTAL	133,179,000	74,805,000	209,484,000

"Therefore, the only possibility of providing gas storage seems to be in the selection of natural formations for operation as aquifer storage fields."

The department says that possibilities for storage are more attractive in Quebec's St. Lawrence lowlands, which are also nearer the fast-growing gas markets of the Montreal area.

The department points out that in view of the large capital investment and relatively long and careful development required, it's important to give proper consideration as early as possible to adequate storage capacity and deliverability in the Montreal area.

STORAGE ACTIVITY BY STATES

State—	Capacity (in M.c.f.) *
Pennsylvania	499,503,000
Michigan	432,888,411
West Virginia	374,211,000
Ohio	363,429,793
California	276,235,044
Illinois	224,225,700
Oklahoma	183,430,000
Iowa	140,000,000
Kansas	98,377,995
New York	96,550,000
Montana	90,840,000
New Mexico	77,200,000
Wyoming	61,400,000
Texas	60,700,000
Missouri	60,000,000
Washington	60,000,000
Maryland	30,000,000
Kentucky	28,169,980
Indiana	16,900,500
Arkansas	15,204,421
Mississippi	6,100,656
Colorado	3,000,000
Utah	
Total	3,198,366,500

*Includes existing and planned total reservoir capacity.

REPRINTS

Reprints of this survey of natural-gas-storage facilities in the United States and Canada are available at 50 cents per copy by writing:

Reader Service Department
The Oil and Gas Journal
Box 1260
Tulsa, Okla.

Rotating disk contactors perform well in propane deasphalting of lube oil

Shell reports good flexibility, quality, and yield from two 8-ft. RDC's installed in modernized facilities at Wood River refinery.

BY V. B. THEGZE, R. J. WALL, K. E. TRAIN, AND R. B. OLNEY
Shell Oil Co.

ROTATING-DISK contactors (RDC's) have proved to be superior to conventional extraction columns for several liquid-liquid extraction systems. Pilot-scale equipment has demonstrated the superiority of RDC's over baffled towers for solvent deasphalting, but until recently no commercial facilities had been constructed.

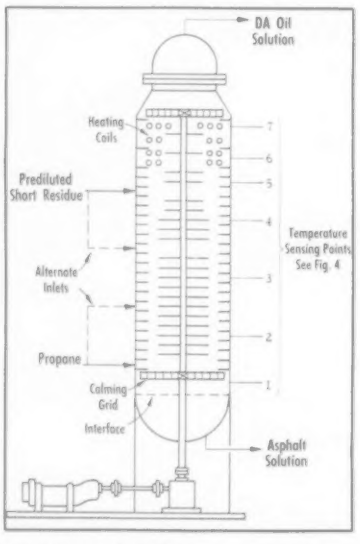
When Shell Oil Co. modernized its Wood River refinery lubricating-oil facilities, two 8-ft.-diameter RDC's were installed. These units are giving excellent performance and provide a high degree of flexibility in operation due primarily to controlled mixing. A good correlation is obtained with pilot-scale equipment, from the standpoint of both capacity and yield for a given quality of deasphalted oil.

Results from several plant test runs show:

- **The RDC has good flexibility,** excellent separating power, and good capacity characteristics in deasphalting operations. Agreement between pilot and plant-scale results demonstrates that an assured scale-up can be made, provided that the pilot RDC is of suitable design and that a sufficient range of rotor speeds is specified in the commercial design.
- **Maximum throughput** achieved at 35 r.p.m. in the plant tower is at least as high as Shell has experienced in conventional deasphalting towers.
- **The good quality and yield** of the deasphalted oils produced have resulted in a number of simplifications and operating economies throughout the lubricating-oil plant. Primarily because of better deasphalting, clay costs for bright-stock treating can be minimized or eliminated entirely as permitted by the crude processed, desired product properties, and other processing steps.
- **Variable rotor speed** gives improved flexibility in the operation since it augments and complements the normal flexibilities imparted by variable top, feed, and bottom temperatures and by alternate feed and solvent ports.

Similar favorable characteristics have been found in pilot RDC studies[1] of propane deasphalting for the production of catalytic cracking feed.

Successful history. RDC was introduced commercially several years ago[2] and has been used successfully in lube-oil extraction,[3] gas-oil extraction, SO_2 extraction, solutizer treating, and phenol recovery from effluents. In addition, the units have been used successfully in chemicals and specialties manufacture and have been favorably evaluated for catalytic reformate extraction.



PRINCIPAL FEATURES of the rotating-disk contactor, propane deasphalting unit. Fig. 1.

When Shell undertook a major revision of the lubricating-oil facilities at its Wood River refinery, RDC's were selected as the most desirable units for the propane deasphalting of short residue from the vacuum fractionating column. Available pilot-plant data indicated a clear superiority for this type of unit over the conventional commercial baffled tower.

For the same quality deasphalted oil, a 3 to 5% yield advantage was indicated for the RDC's in the deasphalting of lube-short residue. In addition, greater flexibility of operation would be provided since the amount of mixing in the contactor could be controlled by the speed of the rotating disks.

A plant design was estimated using the available pilot-plant data. The expected conditions for plant operation, however, differed somewhat from those studied in pilot scale and the installation of a single plant contactor would have required a 60-fold scaleup in diameter from the pilot unit.

Therefore, some conservatism in design was introduced and two RDC towers were installed. Also, two towers would permit future operation in series for propane fractionation. Each tower is 8 ft. in diameter and 32 ft. long.

Tower Features

The principal features of the tower are illustrated in Fig. 1. The vessel shell is of carbon steel, designed for 660 psig. and 400° F. It is fitted with two feed ports, two solvent ports, and a top and bot-

tom-product drawoff. The internals consist of stator rings affixed to the vessel wall, a rotating element driven by a variable-speed drive through the bottom of the column, heating coils, and calming grids.

The main contacting zone, between the upper feed port and the lower solvent port, contains a number of compartments, estimated to be equivalent to four theoretical extraction stages. The rotor-disk sizes were varied in this section to compensate for the shrinkage of internal flows. Four compartments, including two large ones which contain the heating coils, are located above the top feed port.

The top settling zone is located above the heating-coil section and the internal asphalt settler is located below the lower solvent port. The bottom-entry, variable-speed drive has proved very successful. Provisions were made to vary rotor speed between 10 and 60 r.p.m. although normal operation was expected to always exceed 20 r.p.m. This feature has permitted flexible and efficient operation at various feed and solvent ratios.

Effects of variables. To determine the relative effects of the available variables on separation and capacity, a series of controlled test runs was conducted. The feed stock used for these tests was short residue produced from Oklahoma City crude in a 36-tray vacuum column. The lower solvent port was used in every case and, in all tests except one, the upper feed port was used. Generally, each test run was of 1 day's duration with charge and products being sampled every 8 hours.

The DA oil yields reported are the average of those determined by tank gagings and those calculated from gravity analyses; the two agreed approximately with the poorest agreement occurring in run No. 12 (82% vs. 76%). Color of the DA oil was determined on diluted samples (85 vol. % solvent and 15 vol. % DA oil). In the capacity runs, the maximum permissible solvent and feed flows at a given rotor speed were determined by observing when the color and other properties of the DA oil solution began to degrade noticeably.

TABLE 2—OPERATION AT VARIOUS TEMPERATURES, RDC DEASPHALTING

Test run—	A	B	C	D	E
Short residue charge, B/D			1,350		
Total propane charge, B/D			13,500		
Solvent ratio, C_3/sh. resid.			10:1		
Temperatures, °F.:					
DA solution outlet (top)	153	143	135	118	108
Prediluted feed	133	132	132	125	125
Propane charge (bottom)	114	107	105	98	97
Gradient	39	36	30	20	11
Rotor speed, r.p.m.			35		
Short residue:					
Gravity, API at 60° F.	19.2	19.8	19.4	19.5	19.6
S.s.U. viscosity at 210° F.	388	381	386	389	394
Ramsbottom carbon residue, wt. %	5.9	5.6	5.5	5.6	5.6
Deasphalted oil:					
Gravity, API at 60° F.	23.5	22.7	22.4	22.0	22.3
S.s.U. viscosity at 210° F.	190	218	226	240	244
Viscosity-gravity constant	0.851	0.846	0.849	0.848	0.847
Ramsbottom carbon residue, wt. %	1.2	1.8	2.1	2.4	2.6
Color, 85/15 diluent, ASTM	3.5	5.0–	5.5	8+	NT*
Yield, vol. %	78.0	86.0	85.5	86.5	89.0
Asphalt:					
Specific gravity at 77° F.	1.024	1.041	1.041	1.048	1.050
Penetration at 77° F.	19	4	2	1	1
Softening point, °F.	134	159	167	168	168

*Nontransparent.

TABLE 1—EFFECT OF ROTOR SPEED AND TEMPERATURE GRADIENT, RDC DEASPHALTING

Test run—	7	1	2	3	6	5	4
Short residue charge, B/D	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Total propane charge, B/D	13,500	13,500	13,500	13,500	13,500	13,500	13,500
Solvent ratio, C_3/sh. resid	10:1	10:1	10:1	10:1	10:1	10:1	10:1
Temperatures, °F.:							
DA solution outlet (top)	153	153	153.5	153	153	153	153
Prediluted feed	131.5	132	132	132	131.5	131.5	131
Propane charge (bottom)	112	112	112	112	128	128	128
Gradient	41	41	41	41	25	25	25
Rotor speed, r.p.m.	20	35	45	56	20	35	56
Short residue:							
Gravity, API at 60° F.	19.6	19.8	19.3	19.4	19.2	19.2	19.1
S.s.U. viscosity at 210° F.	408	400	407	403	400	405	408
Ramsbottom carbon residue, wt. %	5.7	5.5	5.4	5.8	5.8	5.7	5.9
Deasphalted oil:							
Gravity, API at 60° F.	23.7	23.6	23.6	23.4	23.2	23.0	22.3
S.s.U. viscosity at 210° F.	198	196	201	203	194	198	203
Viscosity-gravity constant	0.826	0.825	0.826	0.827	0.830	0.831	0.836
Ramsbottom carbon residue, wt. %	1.5	1.5	1.5	1.5	1.4	1.5	1.5
Color, 85/15 diluent, ASTM	4.0–	4.0–	4.0–	4.0–	4.5–	4.5–	4.0–
Yield, vol. %	78.0	81.1	82.1	83.0	76.8	80.3	83.3
Asphalt:							
Specific gravity at 77° F.	1.018	1.034	1.041	1.042	1.013	1.028	1.042
Penetration at 77° F.	24	4	1.5	1.5	38	8	1
Softening point, °F.	130	149	163	165	122	144	163

The operating pressure for all runs was 425 psig. Of the total solvent flow listed in the tables, 10% was used to predilute the short residue feed and 90% entered the bottom solvent port. Data from these runs are presented in Tables 1 through 4 and Figs. 2 through 7.

Speed and temperature. The effect of rotor speed and of temperature gradient on separation, all other conditions being equal, are shown by the data presented in Table 1. Rotor speed has a substantial effect on the quality of the asphalt produced and some effect on the yield and viscosity of the DA oil. Thus, in runs 6, 5, and 4, increasing the speed from 20 to 56 r.p.m. results in a reduction in asphalt penetration from 38 to 1 dmm., an increase in oil yield from 77% to 83%, and about 5% increase in oil viscosity.

This improvement appears to be the direct result of higher mass-transfer rates when speed is increased. The quality of the DA oil is not sensitive to rotor speed and has been satisfactory at all speeds when nominal temperature levels and gradients are used.

The manner in which asphalt softening point and DA oil yield, color, viscosity, and carbon residue change with rotor speed and temperature gradient for the seven runs presented in Table 1 are shown in Fig. 2. For all these runs the Ramsbottom carbon residue of the DA oil did not exceed 1.5%, and the diluted ASTM color was no darker than 4.5 minus. These data also indicate that increasing the temperature gradient from 25° F. to 41° F. (at constant top temperature) gives a harder asphalt and decreases the viscosity-gravity constant of the oil but has a small or inconclusive effect on the other properties.

Temperature changes. Data shown in Table 2 and Fig. 3 illustrate the effect of simultaneous changes in top, bottom, and gradient temperatures on product properties at constant feed and solvent rates and at a constant rotor speed of 35 r.p.m. Decreasing the temperature levels and the gradient serves to shift the cut point in the tower so that a harder asphalt is produced along with a larger quantity of poorer-quality oil.

A change in feed-port location also affects the asphalt-oil split. Two runs were made at about the conditions shown for run No. 5 to compare the upper and lower feed-port locations. Feeding through the lower inlet produced a softer asphalt (penetration increased 8 units) and 1-2% lower yield of DA oil.

The effects of temperature gradient, rotor speed, and solvent ratio on the metals content of the DA oil are evident from the data presented in Table 3. Vanadium rejection averages about 97% for the four runs with nickel removal being about the same. Metals-rejection efficiency is poorer for the one run at 7.4 solvent ratio than for the other three runs. However, the close approach to flooding conditions in this run may have had some effect on the metals rejection.

Heating section. The purpose of the heating section near the top of

TABLE 3—METALS CONTENT OF SHORT RESIDUE, DA OIL AND ASPHALT, RDC DEASPHALTING

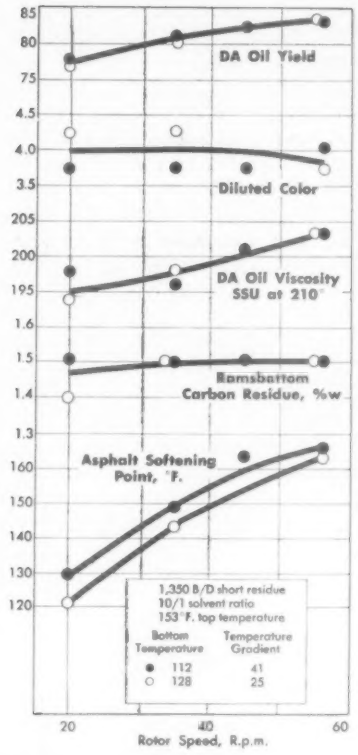
Test run—	1	3	4	†12
Short residue, B/D	1,350	1,350	1,350	1,920
Solvent/oil ratio	10/1	10/1	10/1	7.4/1
Temp. gradient, °F.	41	41	25	25
Rotor speed, r.p.m.	35	56	56	56
Iron, p.p.m.:*				
Short residue	33.3	31.5	31.3	20.1
DA oil	2.0	1.0	0.80	0.90
Asphalt	134	171	149	93.9
Vanadium, p.p.m.:*				
Short residue	20.4	25.6	25.0	21.2
DA oil	0.55	0.50	0.75	0.95
Asphalt	106	103	113	80.4
Nickel, p.p.m.:*				
Short residue	12.6	17.4	12.5	11.7
DA oil	0.55	0.40	0.55	0.60
Asphalt	47.1	71.2	78.0	44.0

*Metals determined by aqueous spark spectrochemical method. †Run 12 is close to flooding conditions.

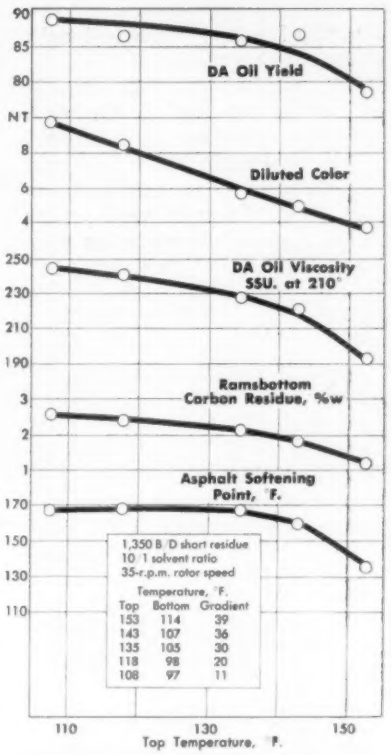
TABLE 4—CAPACITY RUNS, RDC DEASPHALTING

Test run—	9*	12†	11‡	10‡	8§
Short residue charge, B/D	3,460	1,920	2,400	1,680	2,200
Total propane charge, B/D	25,600	14,200	24,000	16,800	16,300
Solvent ratio, C_3/sh. resid.	7.4:1	7.4:1	10:1	10:1	7.4:1
Temperatures, °F.:					
DA solution outlet (top)	151	153	153	153	153
Prediluted feed	131	130	133	129	135
Propane charge (bottom)	128	128	128	128	128
Gradient	23	25	25	25	25
Rotor speed, r.p.m.	35	56	35	56	56
Short residue:					
Gravity, API at 60° F.	19.2	19.3	19.5	20.4	
S.s.U. viscosity at 210° F.	412	391	400	394	
Ramsbottom carbon residue, wt. %	4.9	5.3	5.6	5.5	
Deasphalted oil:					
Gravity, API at 60° F.	23.4	23.5	23.8	23.5	
S.s.U. viscosity at 210° F.	196	198	198	198	
Viscosity-gravity constant	0.828	0.824	0.824	0.826	
Ramsbottom carbon residue, wt. %	1.5	1.4	1.5	1.4	
Color, 85/15 diluent, ASTM	4.5	4.0	4.5—	4.0	
Yield, vol. %	76.6	79.0	80.6	82.1	
Asphalt:					
Specific gravity at 77° F.	1.010	1.020	1.030	1.046	
Penetration at 77° F.	61	21	10	2	
Softening point, °F.	118	132	145	161	

*Cycling DA oil flow over 10-hour period, but no dark oil produced. †Steady operation at 1,920 B/D; at 2,160 B/D, DA oil progressively darker over 4-hour period. ‡Steady operation indicated over 24-hour period. §Steady operation at 2,200 B/D; dark DA oil produced at 2,290-2,360 B/D.



EFFECT OF ROTOR SPEED on asphalt yields and properties. Fig. 2.



EFFECT OF TEMPERATURE on asphalt yields and properties. Fig. 3.

the tower is to precipitate heavy resins and intermediate asphaltene fractions from the primary extract by raising the temperature of the solvent-oil solution as it rises from the contact zone. The proper balance between contacting in the vicinity of the feed zone and heating above that zone achieves good yield and quality of deasphalted oil.

The manner in which this is achieved in the RDC is as follows: The steam coils are installed in two compartments above the top feed inlet port (Fig. 1). These compartments are stirred to insure high heat-transfer rates. Immediately below the coils and extending down to about point 4 is a short, compartmented section in which small rotor disks are installed. This provides sufficient unrestricted cross-section to handle the increased internal flows resulting from the temperature gradient and solvent action.

Dissolution of the remaining oil fractions from the asphalt phase occurs in the main section below point 4; this action proceeds most efficiently at a lower, relatively constant temperature.

Measured temperature profiles, shown as functions of rotor speed and propane charge temperature, are shown in Fig. 4. The operating conditions are those of runs given in Table 1. The main temperature change occurs in the region bounded by the top heating coil and point 4. Thus, the bulk of the exchange between oil and asphalt phases is restricted to this region and a sharp split between oil and asphalt is obtained over-all.

Penetration, softening point. The relationship between asphalt penetration and softening point for all the test runs is shown in Fig. 5, and the interrelation of Ramsbottom carbon residue and viscosity of the DA oil in Fig. 6. These curves indicate that the characteristics of the short residue feed did not change significantly during the tests.

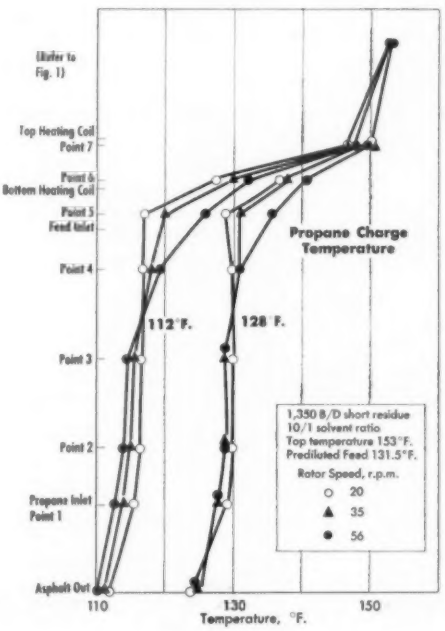
Maximum throughput. The maximum throughput runs given in Table 4 may be correlated in terms of the two groups

$$\frac{V_C + V_D}{C_R} \qquad \frac{N^3R^5}{HD^2}$$

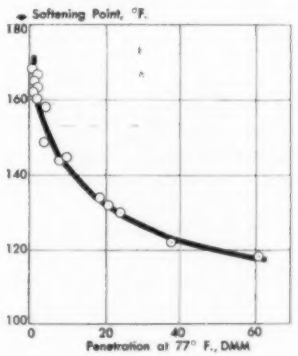
Where:

- D = column diameter, ft.
- H = compartment height, ft.
- N = rotor speed, rev./sec.
- R = rotor disk diameter, ft.
- V_C = superficial velocity of continuous (solvent) phase, ft./hour
- V_D = superficial velocity of dispersed (short residue) phase, ft./hour

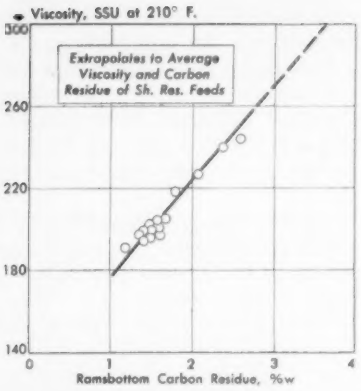
The constriction factor, C_R, is de-



TYPICAL TEMPERATURE PROFILES in the contactor. Fig. 4.



ASPHALT SOFTENING POINT as function of penetration. Fig. 5.



DEASPHALTED OIL VISCOSITY as function of carbon residue. Fig. 6.

fined in terms of the appropriate rotor and stator dimensions for a given internal geometry. The data are shown in Fig. 7 where the open points refer to runs giving steady operation but close to flooding, and the closed symbols are for runs in which a dark DA oil was produced or cyclic oil flow was observed. The permissible throughput at the higher speed, 56 r.p.m., is about two-thirds of that obtained at 35 r.p.m.

The curve drawn through the points has a shape typical of that found for a pilot RDC. Also, curves of similar shape are obtained in other RDC process studies.[2,3]

Pilot extraction. Data have been obtained on the same Oklahoma City short residue in a 2.3-in.-diameter pilot RDC in which a sufficient number of compartments were installed to give a close approach to the ultimate extent of extraction at a given solvent ratio. Fig. 8 illustrates the separation efficiency of the pilot and plant units expressed in terms of carbon residue and yield of the deasphalted oil.

A range of temperatures and solvent ratios was used in the pilot study corresponding approximately to those detailed in Tables 1, 2, and 4 for the plant tower. The plant unit gives about the same yield-quality relationship as obtained in the pilot studies, indicating that the basis used in scaling up to plant size is a satisfactory one.

Capacity results. Results of the capacity runs made in the pilot unit are given in Fig. 9. Also shown for comparison is the capacity curve for the plant tower, taken from Fig. 7. The specific throughput is about the same in the two units at the same power per unit mass (N^3R^5/HD^2). This indicates that a satisfactory basis for scaleup of diameter is at hand. Also, any small differences in performance that occur between pilot and plant-scale units generally can be adjusted by some change in rotor speed.

The agreement between the pilot-scale and plant-scale results is gratifying, in view of the 42-fold difference in diameter.

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2. Reman, G. H., and Olney, R. B., "The Rotating Disc Contactor—A New Tool for Liquid - Liquid Extraction": Chem. Eng. Prog., 51, 141 (1955).
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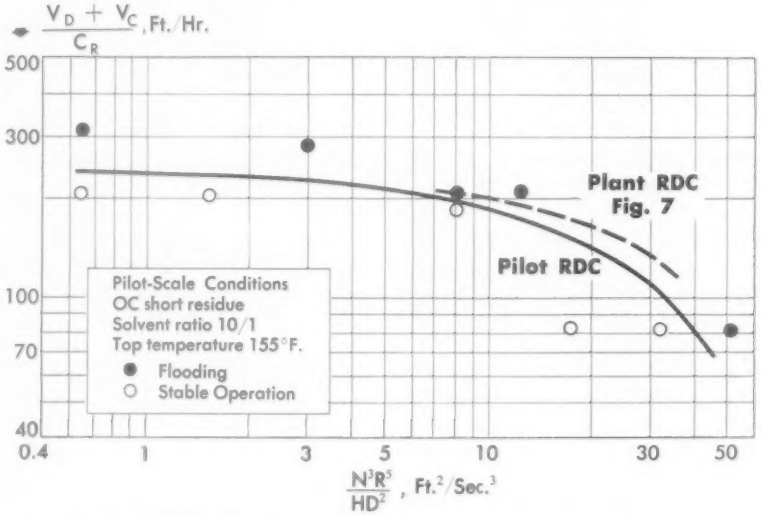
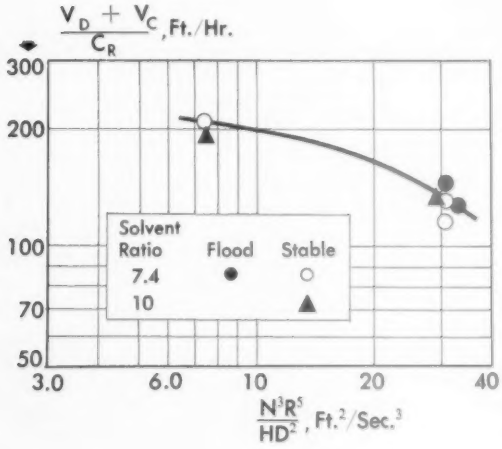
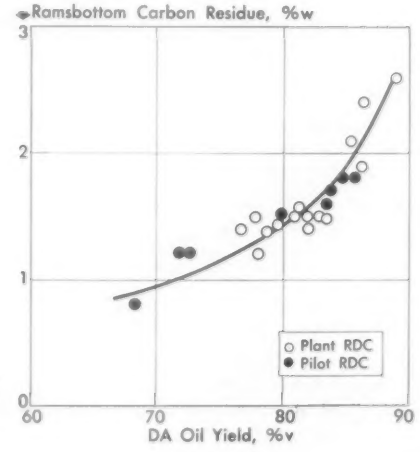


PILOT UNIT CAPACITY, RDC for propane deasphalting. Fig. 9.



CAPACITY curve and plant deasphalting contactor. Fig. 7.

SEPARATION efficiency in propane deasphalting. Fig. 8.



SKID-MOUNTED CONSTRUCTION gives savings in piping and labor for this compact gas-processing plant. Towers from left to right are: absorber, rich-oil deethanizer, still, depropanizer, debutanizer, and at the extreme right, another absorber. The products deethanizer isn't shown.

Little plant with big ideas

BY HUGH S. PYLANT
Petrochemical and Gas-Processing Editor

THE BIG and the little seem to be the predominating trends in gas-processing plants nowadays. There has been a demand for large plants with capacities ranging from 500 to 1,000 M.M.c.f.d. to handle comparatively lean pipeline gas, and for small plants with capacities from 5 to 30 M.M.c.f.d. to process rich field gas.

Large plants usually had elaborate processing techniques such as low-temperature absorption, dry-still stripping, high dew-point depression dehydration, fractionation train, etc.; while the smaller plants were designed with a very simple flow scheme and the minimum of equipment necessary for extracting recoverable hydrocarbons from the gas.

Now it appears that a small plant can be built containing all the elaborate features of the larger installations and operate just as efficiently and economically.

Graridge Corp. has installed one of these deluxe, miniature plants near Breckenridge, Tex., that has a capacity of 18 M.M.c.f.d. Liquid production from about 8 M.M.c.f. of gas daily that is presently being put through the plant runs around 20,000 gal. per day with better than 75% propane recovery.

Maloney-Crawford Tank & Manufacturing Co., designer and fabricator of the skid-mounted plant, said that an installation like this costs around $600,000 and can be on stream within 6 months from date of order.

Plant description. Two gas streams come into the plant at different pressures and are processed in separate absorber systems. Outlet gas from the absorbers goes into two high-pressure sales lines. Ethane residue from the rich-oil and product deethanizers is used primarily for fuel with any excess going into a low-pressure residue sales line.

The flow scheme includes high dew-point depression glycol dehydration of the gas prior to entering the absorbers, low-temperature absorption, rich-oil deethanizing, dry-still stripping, and product fractionation into propane, butane and/or LPG, and 14-lb. R.v.p. natural gasoline.

GRARIDGE PLANT GAS ANALYSES

	Graridge gas		Gulf gas	
	Gal./ M.c.f. (Inlet)	Gal./ M.c.f. (Outlet)	Gal./ M.c.f. (Inlet)	Gal./ M.c.f. (Outlet)
C_1	...	...	...	...
C_2	...	...	...	...
C_3	2.32	0.09	1.53	0.06
iC_4	0.28	0.01	0.15	0.01
nC_4	0.84	...	0.38	...
iC_5	0.20	...	0.08	...
nC_5	0.25	...	0.09	...
iC_6	0.08	...	0.04	...
nC_6	0.07	...	0.04	...
C_7+	0.20	...	0.06	...
	4.24	0.10	2.37	0.07

A total of 300 tons of propane refrigeration is used to chill the gas and 156 g.p.m. of 125-mol. wt. lean oil to 20°-25° F. The plant makes its own absorption oil from heavy ends.

All pumps are electrically driven except the glycol and raw-feed which use reciprocating gas drivers. Water is used for cooling and a direct-fired heater supplies heat for the still and reboilers. Instruments are pneumatic other than electric controls on the compressors.

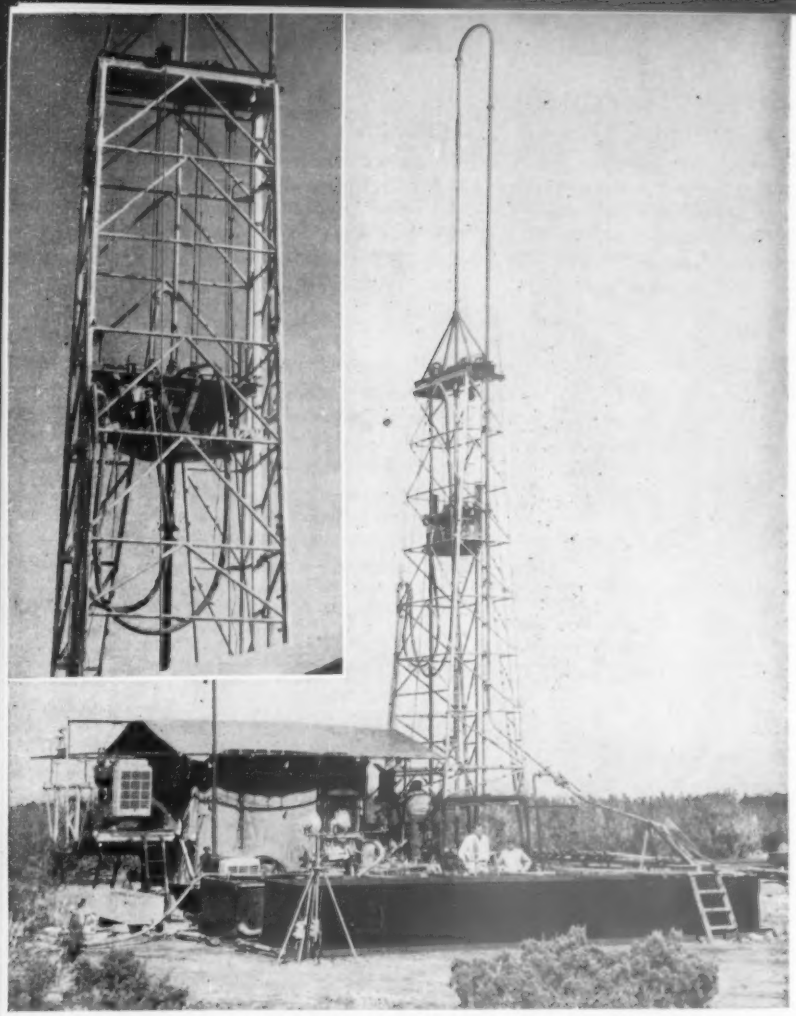
One full-time operator is on duty each shift. And outside maintenance help is used when required.

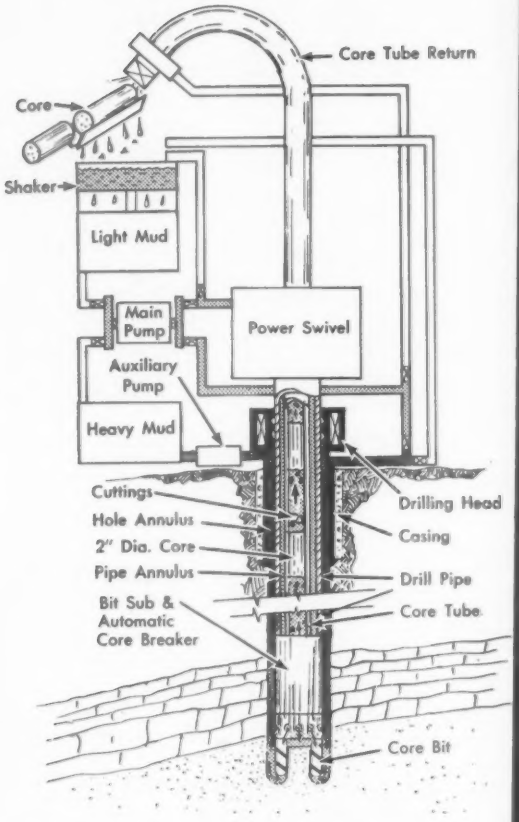
Daily liquid production of the plant at present breaks down something like this: 9,600 gal. of propane, 6,400 gal. of LPG, and 4,200 gal. of 14-lb. R.v.p. natural gasoline.

This unit has been on stream for about 1 year and its operation has been highly satisfactory. "The plant is very efficient and at present is almost trouble free. . . . It would be difficult to have a more efficient stripping operation," said Lester Clark, Graridge president. The plant is expected to be operating at full capacity in the near future.

Economy. According to the manufacturer, these complete, compact, skid-mounted plants can be economically installed to recover as little as 8,000 to 10,000 gal. of product per day or with an approximate gas capacity of 4 to 5 M.M.c.f.d. The upper limit for this type unit will be a gas capacity of around 25 to 30 M.M.c.f.d. or approximately 75,000 to 100,000 gal. per day of liquid recovery. The plants are designed and built so that they can be moved for about 30% of the original cost.

Apparently the key to the low cost of these small plants is that only one organization is involved in the building from start to finish. This compares to many subcontractors and suppliers that usually take part in the conventionally built plant. Also, shop fabrication and skid-mounting cuts down on the more expensive field labor costs and the quantity of piping required.





STRATO DRILL'S RIG 1 on location in Glasscock County, Texas. Loop over mast is core-return tube through which cores are circulated to surface as soon as they are drilled. This pilot-model rig pulls singles, can take continuous core to 3,000 ft. or deeper. Insert shows power swivel. Reverse circulation is the key to the continuous-core method. (Drawing) Fluid is pumped down annulus between drill pipe and core tube; it goes out into open hole just above the bit and then rises to surface through core tube. Cores and cuttings come up with ascending fluid.

Year-long field test successful for

Continuous-core drilling rig

The Journal reported on Page 48 of the January 4, 1960, issue that a revolutionary new rig had commenced its first drilling under contract. Since that time, the pilot-model rig has worked for a number of oil companies, some of which evinced real enthusiasm for the continuous-core concept. Some engineers believe the method will find a definite place for itself among the industry's oil-exploration tools.

BY HOMER I. HENDERSON
President, Strato Drill, Inc., Houston

THERE ARE several things which stand out in our experience in drilling with the new continuous-core rig.

First of all, the drilling method itself is sound. The cores are recovered. The information they give is valuable. The bits drill extremely long distances. Circulation isn't lost.

Pictures on these pages were made by the Journal while the rig was drilling in Glasscock County, Texas. The article itself is adapted from one presented by Henderson titled, "Continuous-Core Drilling Rigs" and presented at the 1961 meeting of API Division of Production's Southwest District at Albuquerque.

EXTRA-HIGH recovery results from continuous coring. Here more than 2,000 ft. of cores are laid out in 100-ft. rows. In harder formations, recovery is uniform 6-in. segments virtually 100% complete. In softer formations, much more than usual percentage is recovered.

CLEAN, FAST CORES are product of the reverse circulation. Broken off in lengths of about 6 in., cores rise to surface at about 200 ft. per minute. Since core is exposed to bottom-hole-mud pressure only short time, it comes up in very few minutes clean and relatively uncontaminated.

CONCENTRIC PIPE lies on pipe racks waiting to be picked up for drilling. Inner tube is one which carries core to surface. Annulus between core tube and outer drill pipe carries fluid down to bit.

The pipe doesn't stick. In short, some of the basic doubts about the reverse-circulation system of recovering continuous cores have proved not to be major obstacles.

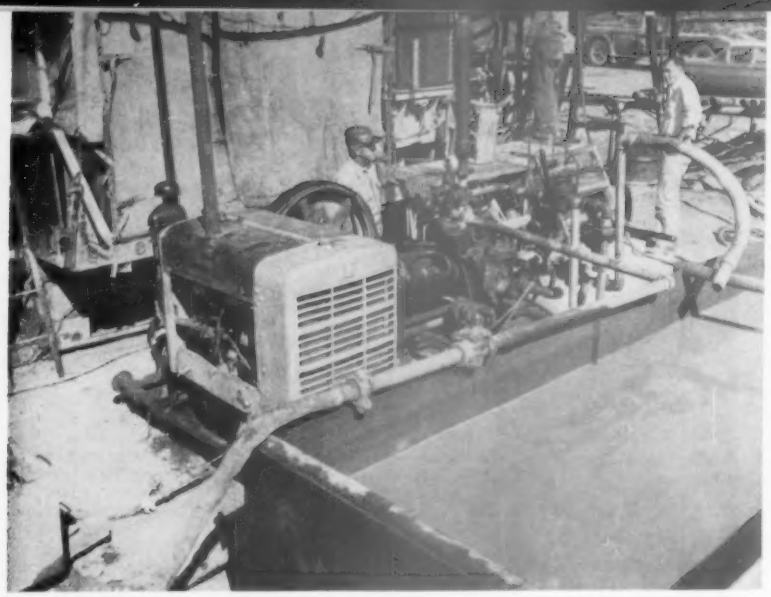
Second, core recovery is exceptionally high. In hard formations, virtually 100% of the core is recovered. In soft formations, cores are recovered which can be crumbled or squeezed through the fingers.

Compared to conventional drilling, the continuous-core hole costs more; compared to conventional cores, the continuous core costs less.

There are still problems. Only after more development will we be able to say accurately how large an application the continuous-core rig will have. At this time, we can be assured it offers savings in drilling shallow core holes for the petroleum industry and for such things as hard minerals, chemicals, construction, etc.

What it is. A continuous - core drilling rig is just what the name implies. As it bores into the earth it leaves a central core, and this core is automatically broken off and carried to the surface by the fluid stream. The geologist and the driller at the well site have a continuous sample roughly simultaneously with drilling. This method uses reverse circulation of fluid.

Why a continuous core? There are many reasons for desiring a continuous - core of the hole. The basic reason is the possibility of



LITTLE PRESSURE OR POWER is required to circulate mud for the continuous-core drilling. This motor-driven pump uses only about 25 to 30 hp. drilling at 2,000 ft. Light mud in tank is used for drilling; heavier mud can be kept in reserve to load hole annulus.

DRILLER'S CONTROL raises and lowers the traveling carriage containing the power swivel. Power swivel allows adding singles without raising bit off bottom.

finding and producing a new barrel of oil at less cost.

The trend in United States exploration is to concentrate on subsurface geology. Some have reduced their exploration activity to 100% subsurface geology. The consensus of geologists is that 75% of the oil left undiscovered in the United States is in stratigraphic traps. These stratigraphic traps, generally, cannot be located by geophysical means, and this explains the trend towards subsurface geology. The core drill was developed to aid the geologist in his subsurface evaluation and exploration. The subsurface geologist has long complained that he needs more detailed, more reliable subsurface information.

A continuous core of the complete geological section seems to be the ultimate in providing information. The cores very accurately determine depths to key horizons, measure dips (both magnitude and direction), detect facies changes, accurately locate faults, pinchouts, sand lenses, porosity traps, overlaps, reefing, minerals other than petroleum, volcanic ash deposits for use as a geological datum plane, channel sands, etc.

Some geologists think that a program calling for few strategically located continuous-core holes is the most economical way to solve many of their problems. The reason they ask for **continuous** cores is: If you know when to core, you already know the geology. There is an old saying: "We only core the breaks. We drill the sand and core the shales." Today the geologists needs to know the complete geology of any interesting area.

The paleontologist uses fossils found in the cores, both microfossils and megafossils, to determine sea and lake conditions at time of deposition. This may lead to location of strand lines or reefing. Complete fossil information helps date formations, and as a consequence, is valuable in locating faults, overlaps, unconformities, etc.

The engineer uses cores of indicated pay zones to evaluate the reservoir and to decide on well-completion procedures. There are no passed pays with continuous-core drilling. The cores obtained are noticeably cleaner than those from conventional methods.

Some geologists think that the first continuous-core hole in any particular area should be logged conventionally: i.e., electric, radioactive, sonic, etc. The logs can be interpreted by comparison with the accurate lithology from the cores. This log, so interpreted, is then a "key" to reevaluate any logs already in the company's file.

How it works. On this experimental drilling rig, drill pipe is substantially full-hole diameter. The size presently being used is 4½-in.-o.d. drill pipe in a 4¾-in. hole. Within this drill pipe is another integral and concentric tube, termed the core tube; it has a diameter of 2½ in. The drilling fluid descends in the annulus between the drill pipe and the core tube, discharges into the hole annulus just above the bit, and ascends within the core tube. The fluid in the hole annulus is normally static.

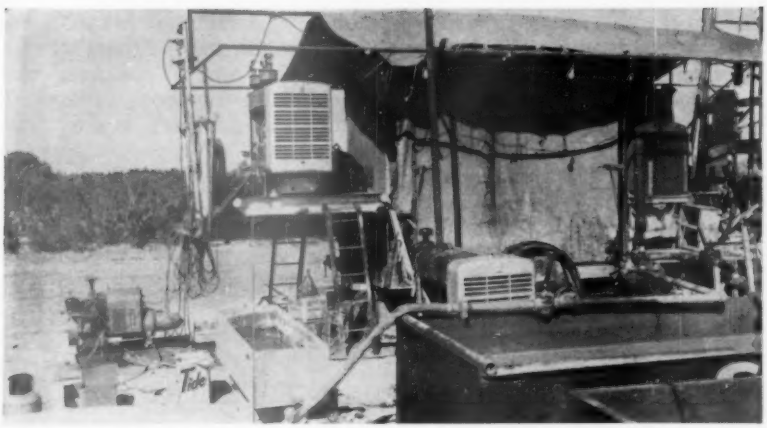
The pipes are rotated by a power swivel. Both drag-type (blade) bits and diamond bits have been used. When the core is 6 in. long, it is automatically broken off by a core breaker just above the bit. The broken core segments, as well as the cuttings, are carried upward by the ascending drilling fluid, through the swivel, the gooseneck, and to the shale-shaker screen.

Two mud tanks are used. One holds light mud which is circulated as a drilling fluid. The other contains heavy mud held in reserve for possible use in the hole annulus or for killing a gas blow. The main pump has a manifold on the suction side to permit the driller quickly to switch the pump intake to either mud tank.

Pressure side of the main pump has a manifold which permits the driller to pump into any one or more of the three conduits: hole annulus, drill-pipe annulus, or core tube. Circulation may be either into or out of any one, or any pair of the three conduits.

The auxiliary pump is for pumping heavy mud into the hole annulus.

Surface hole is drilled in a con-



ROTARY POWER to turn swivel comes from the motor-driven d.c. generator mounted on the gooseneck of the main rig trailer. Extremely small power requirement means that rig is cheaper to buy and uses less fuel than conventional rigs.

ventional manner with fluid descending in both pipe annulus and core tube and ascending in the hole annulus. Surface pipe is set and cemented to protect fresh-water sands. A drilling head is then placed on top of the surface casing.

When coring starts, the hole annulus fills with the circulating mud. This fluid is normally kept very light to speed drilling to keep minimum pressure on the formations. It is inhibited to prevent hydration of shales and is usually an oil-emulsion mud.

Should the well hit formations with high pressure, result might be pressures high enough to hydraulically fracture shallow formations. To prevent such a situation, always within the driller's view is a pressure gage showing the pressure within the hole annulus just under the drilling head. Should this pressure start rising unduly the driller opens a valve to permit the auxiliary pump to pump heavy mud into the hole annulus.

As the hole annulus mud is static, it cannot gas-cut except by diffusion, which is a very slow process. The heavy mud is especially prepared to assure good lubrication and low water loss. In case of lost circulation this hole-annulus mud may carry lost-circulation material.

The power swivel is powered with two direct-current electric motors (20 hp. each) with Ward Leonard control of torque and speed.

Power swivel is part of carriage which rides on guides installed inside the mast. One hose carries mud from standpipe to drill pipe; second carries returning mud and cores to the shale shaker. Drilling line operates through blocks in crown and on carriage to control bit weight.

The drill-pipe can be rotated at speeds from zero to 350 r.p.m.; it is made up and broken out with the power swivel.

Weight on the bit for these experimental tests has ranged up to 300 lb. per in. of bit diameter.

In some sections it may be of no value to recover cores. If so, any type of full-hole bit can be used with the circulation in the same manner as when coring, or, if desired, in a conventional manner. Any size hole (within reason) can be drilled—either with core bit or full-hole bit.

Drilling Results

The rate of penetration to date leaves something to be desired. It compares favorably with conventional coring. However, we are usually more interested in cost per foot of hole, and here continuous-core drilling compares less favorably.

Core recovery has been excellent, in most cases 100%. Cores have been recovered that you could not expect to get in conventional coring; friable sands that crumble in the hand, and clay and sand-clay cores that squeeze through the fingers. All of the usual sedimentary formations, as well as all the usual evaporite formations, have been cored successfully. Loose sands are not cored as such, but in this method the only place from which cuttings can come is the bottom of the hole. As a consequence, when drilling loose sands, only loose sand is recovered in the returns and the geologist knows what is being drilled and has continuous samples of it.

The rig has cored over 12,000 ft. total with a surprisingly high recovery. The reason for excellent recovery lies in the very basis of the continuous-core drilling method. The core is not pushed, or wedged, into a tightly fitting core barrel, or one that may have its relief valve plugged by slough material. Nor is the core required to have enough strength to turn a core-barrel swivel. In the continuous-core method, if the core has sufficient strength to stand up while being cut, it is thereafter a free-floating body in the drilling fluid until it is deposited upon the core tray a short time later.

The cores are noticeably cleaner because they are subject to mud pressure for much shorter time. Normal rate of core travel up the core tube exceeds 200 ft. per minute.

We have had four fishing jobs, all caused by defective experimental pipe. In all cases the fish was caught and quickly recovered.

As one would expect the holes have been straight, never off vertical as much as 1°.

Hole doesn't slough. Probably the most surprising thing is that there is practically no hole caving or sloughing. Holes have been drilled in the recent formations of the Gulf Coast (Harris County, Texas), the Upper Cretaceous sands and clay of Bastrop County, Texas, and the Permian and Upper Pennsylvanian section of Crockett and Shackelford counties, Tex. Nowhere was there trouble with wall sloughing.

In one case were were doing some research drilling in the Permian section. We drilled on daylight tours only and the pipe was left on bottom overnight. There was no trouble whatsoever with sloughing. One hole, at 2,100-ft. (1,900 ft. open hole) was left standing for 7 weeks. When we reentered it, we found it had only 2 ft. of sloughing material in the bottom. The reason is that in conventional drilling the ascending mud flow rapidly erodes the hole walls. Probably what is still worse on shale is water-base mud flowing by a water-thirsty shale section 24 hours per day, causing hydration, swelling, and sloughing.

One test was made drilling with air. It was a short run because the hole was weeping salt water. Results were favorable; cores were satisfactory and drilling rate in both shales and hard limestone improved.

A high-pressure blowout is less likely with the continuous-core method than with conventional drills. The drill pipe could not ordinarily be blown from the hole because of its weight and small effective area. The core-tube channel is the line of least resistance for a high-pressure blow because of the light mud in it coupled with the fact that it circulates and can become gas cut. To kill such a blow, the driller immediately switches the suction of his main pump to the standby tank of heavy mud and pumps heavy mud into the drill-pipe annulus, as well as the hole annulus.

Cost of Drilling

Cost of experimental drilling with this prototype drill has been more than conventional drilling. This is to be expected in all development programs. We aren't certain just what eventual cost per foot will be. It is possible cost will always exceed conventional drilling. If so, we must measure the value of the better information we gain. In the final analysis the operator is interested in reducing over-all costs of finding a new barrel of oil and putting it into the lease tank. If the continuous-core method cannot make this saving then it has contributed nothing.

Certain savings are inherent with this method of drilling, viz., the hole size and pump size. There is a big cut in hydraulic pressure, pump volume, and pump horsepower. The savings made possible by smaller holes, if drilled efficiently, are: less mud, water, and cement, less total horsepower and fuel, less initial drilling-rig cost, lower drilling-rig weight, lower moving and road-building costs, less labor costs, less drill-site preparation, cheaper casing, etc.

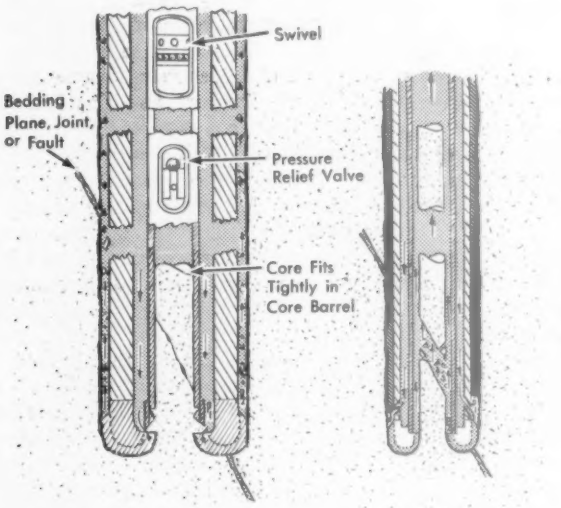
Moreover, logging costs are much less.

There are other savings specific to exploration drilling. For one, the geophysical budget may be reduced. Today the average geophysical cost of finding one producing structure is approximately $1,000,000 and the prospect must still be drilled. Strategically located continuous-core holes may possibly be the least expensive way to solve geological problems, especially if the core-hole provides a "key" log to reevaluate older logs in the company files.

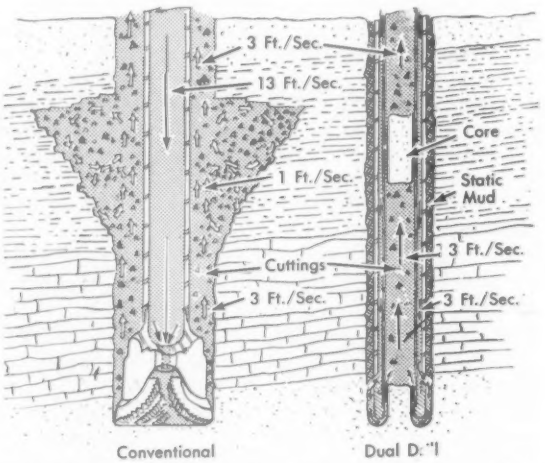
Most of the old oil provinces of the United States have been surveyed many times with geophysical methods. Some ranches have been "shot" scores of times. One survey of an area with a continuous-core program should write finis to all future exploration of that area, one way or the other. It may be one may find more oil per dollar with continuous-core holes for detailed subsurface geology to locate "strat" traps and structures with relief under the resolving power of geophysics.

For production drilling. There are certain savings drilling producing wells:

1. Pipe and fittings for the small-diameter hole are cheaper.
2. Less mud, cement, etc. is used.
3. Drill-stem test can be made with the continuous-core drilling rig. It is possible to swab in a well for testing without pulling the pipe from the hole. It is possible to fluid up and drill deeper and test again without coming out of the hole. Hence one can test and drill until he either gets a "keeper," runs into water, or runs out of pay. The test can be long enough to determine productivity before setting pipe.
4. An operator can, after a drilling break, circulate the first core to the surface before drilling deeper into a possible pay zone. If the core indicates a pay, the mud can be converted to a water-in-oil emulsion to prevent "watering" the pay section.
5. The complete geologic information obtained from the continuous core, plus the high-percentage recovery of pay cores, gives better control for location of development wells. As a consequence, it could save unnecessary dry holes.



REASON for good recovery of cores in the continuous-core method is that each core segment becomes free body after it is broken off. In conventional core barrel, cores can become jammed; softer formations disintegrate and can seldom be recovered. Continuous cores rise to surface with little mechanical damage.



LITTLE HOLE WASHOUT is found in continuously cored holes. Conventional drilling pumps eroding mud past exposed formations almost continuously. With core drill, hole annulus is static so there is no erosion; hydration of shales can be controlled by using special fluids in annulus.

PART 5—HEAT TRANSFER

Here are principles of heat-exchanger construction

GENERAL CONSTRUCTION of shell and tube exchangers consists of a bundle of parallel tubes inside a shell. One fluid passes through the shell (outside the tubes) and the other fluid passes through the tubes. The headers at the ends of the exchanger can be constructed to provide several "passes" on the tube side.

A number of "passes" on the shell side may also be obtained by installing baffles inside the shell parallel to the tubes. Baffles are also installed perpendicular to the tubes within each pass to direct the fluid in the shell against the tubes. The purpose of more than one pass is to control the velocity of the fluid in the tubes and the shell and to allow closer temperature "approach" between the two fluids.

Shell and tube equipment is compact and efficient. High velocities through this equipment improve the rate of heat transfer.

General details of construction for shell and tube exchangers are shown in Fig. 10. Tube bundles are made up of a large number of tubes, the end of which are expanded into two tube sheets (one at each end). One tube sheet is held fixed and the other is free to move to allow for thermal expansion of the tubes. The one free to move is called the floating tube sheet.

Mounted on the tubes are baffles and tube-support plates which are held in position by tie rods from the fixed tube sheet. The tube-side fluid enters through a channel section and flows through the tubes into a cover attached to the floating tube sheet. Both the channel and the floating-head cover are suitably baffled to give the tube side the required number of passes to suit the process conditions.

In Fig. 10 the shell-side fluid enters the shell at one end, is guided through suitable baffles over the bundle and leaves at the other end. The tube-side fluid enters and leaves through the channel, making two passes through the tube bundle.

Fig. 11 shows an exchanger that has two passes on the shell side and four passes on the tube side. Construction is similar to that of the single-pass exchanger except for the addition of a longitudinal baffle and the relocation of the shell nozzle.

Extended surface exchangers are best known by such trade names as "Fin-tube" or "G-Fin." General details are shown in Fig. 12. They are simply special types of shell and tube exchangers. They are used primarily where one fluid will have a greater resistance to heat flow than the other. In such cases, the added surface due to the "fins" evens out the resistance to heat flow of the two fluids.

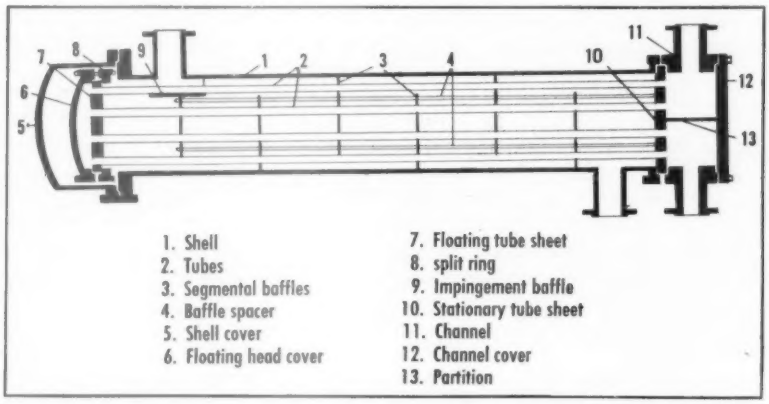
The exchanger consists of a pipe within a pipe, with both inner and outer pipes having a return bend at one end. The inner pipe is fitted with suitable fins while the outer pipe serves as the shell. These units come in standard sizes up to about 100 sq. ft. of external surface. They are compact, low-priced, and may be easily hooked up in parallel or series flow.

Cleaning and maintenance. Since a marked increase in pressure drop and decrease in heat transfer occurs as exchangers become fouled, any exchangers subject to fouling should be cleaned periodically. Bypasses in the piping are sometimes provided so that exchangers may be removed from service and cleaned during the run.

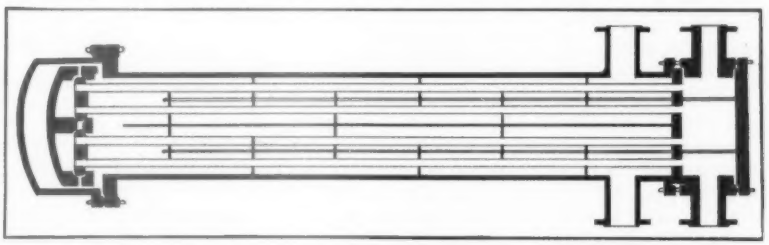
There are several methods in use for cleaning.

1. Insides of the tubing may be drilled out mechanically and the outside cleaned by hosing and washing.
2. The tube bundle may be heated in a bath of hot gas oil and caustic.
3. The exchanger may be cleaned by circulating inhibited acid through it.
4. The tube bundle may be cleaned by a wet sand-blasting procedure.

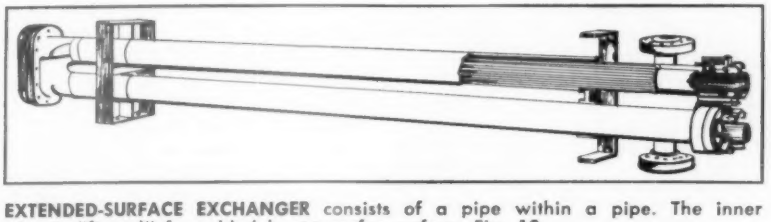
This material taken from process-training-program manual, Bayway, N. J., refinery of Humble Oil & Refining Co.



CONSTRUCTION DETAILS for a typical shell-and-tube exchanger. This type has one pass on the shell side and two passes on the tube side. Fig. 10.



THIS TYPE OF SHELL-AND-TUBE EXCHANGER has two passes on the shell side and four passes on the tube side. Construction details are similar to those in Fig. 10. Fig. 11.



EXTENDED-SURFACE EXCHANGER consists of a pipe within a pipe. The inner pipe is "finned" for added heat-transfer surface. Fig. 12.

Shell Pipe Line calls it

DYNAMIC PROGRAMING

It's proving effective as a means of optimizing power on crude-oil pipelines

BY J. T. JEFFERSON
Shell Pipe Line Corporation
Houston

NEED for a comprehensive procedure to optimize power costs has long been recognized by Shell Pipe Line Corp. To satisfy the need, a formal solution method was developed known as "dynamic programing." How this method functions to optimize power on crude pipelines is here told.

Minimizing the expenditure for electrical energy consumed in operating Shell's crude pipelines has required considerable effort. The expenditure represents a significant percentage of all direct costs incurred in operating major trunk lines of the system.

A multistage allocation procedure was decided upon as most suitable for the particular problem of pump-combination selection.

Multistage method. The multistage allocation method applies to processes which may be broken up into sequential steps or stages, such that the input to each stage consists entirely of the output of the previous stage.

The minimum total pressure required of all stations to maintain desired throughput then determined optimum values of pressure for each station.

One problem that offers opportunity for study is that of relating historical demand to cost.

Finding Power Costs

Operating personnel face each month the problem of finding a distribution of pumping load among the stations of a given line that minimizes the total power bill. For the most part, pumps on major crude pipelines are constant-speed centrifugals. Each station may contain four or more such pumps of different sizes.

Required variation in pressure is obtained by using the pumps in combination. Finding the proper combination of each station on the line is the problem. The situation is complicated somewhat by the fact that large lines generally are served by several different public utility companies and each offers electrical power at a cost determined by different contract schedules.

It is necessary to insure that maximum energy is utilized at those locations where it is cheapest. Within limits, however, energy usage distribution can be shifted from station to station along the line without violating pressure requirements.

The magnitude of the problem may be appreciated for an extreme case by considering it in terms of the Ozark System, one of the major trunklines operated by Shell. Each of the 10 stations may be operated, subject to pressure limitations, at any of 10 different pump combinations.

Many possibilities. Although in a typical month, hydraulic requirements considerably reduce the number of possible pumping schemes, the ones remaining may number in the thousands.

Past selection of optimum com-

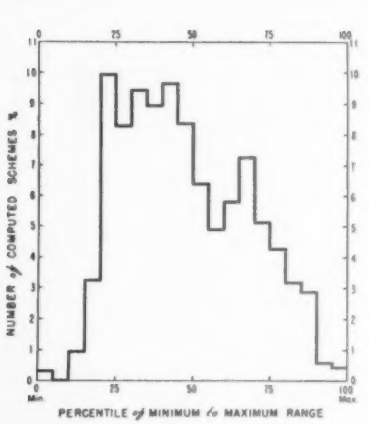


Fig. 1.

GRAPHIC ILLUSTRATION of the variation in cost that may be obtained in selecting pump combinations for a projected month's line operation. The line in question is a 10-station, 438-mile, 22-in.-diameter line carrying 230,000-280,000 B/D.*

Distribution in computer power costs is given for 631 different feasible pump combination schemes, for a projected throughput rate of 240,000 B/D. Of these schemes, the most expensive gave a system power cost of $110,774. The optimum, or least-expensive scheme, had a power cost $3,655 less than the maximum. The per cent of the schemes which had costs in each 5% interval of the $3,655 range, minimum to maximum, is plotted in the form of a frequency distribution.

The plot suggests that an unskilled selection of an operating scheme would probably yield a cost of about $109,000. As the minimum cost available would be $107,119, the unnecessary cost incurred with such a selection would be $1,889, or 1.8% of the total. The worst possible selection of an operating scheme, of course, would incur $3,655 of unnecessary cost for the month amounting to 3.4% of the total.

*These data were originally reported by T. R. Young in a paper, "Digital Simulation of Crude Oil Pipe Lines," presented at the API annual pipe line conference, Tulsa, April 28-29, 1960.

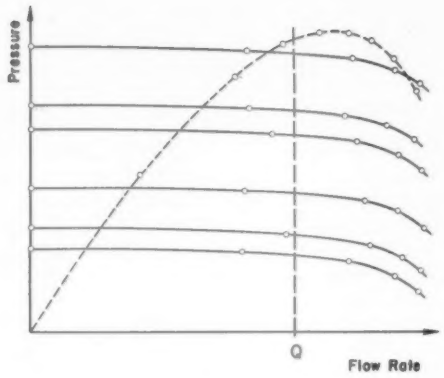


Fig. 2.

SOME MEANS must be found for placing line operating parameters in computer memory in order that the computer may perform incidental calculations, such as those necessary to the specification of line hydraulic requirements. The figure schematically depicts a set of head-capacity curves and an efficiency curve (dotted), representing the pump combinations available at a typical station with constant-speed centrifugal pumps.

The circles shown are values of pressure for each curve chosen to represent that curve in memory. In computer language, the pressure value for a given throughput (Q) and pump combination is obtained by table lookup and linear interpolation.

By assigning the responsibility for such calculations to the computer, and hence avoiding extensive and detailed data preparation, the optimization program is made considerably more accessible. For example, the program described in the text requires as input information only values of desired throughput, and of viscosity and gravity of the crude to be pumped.

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binations was made on the basis of experience and practical rules of procedure. Although cumulative experience has led to the development of extensive tables of low-cost combinations, it generally is agreed that only a small percentage of cases arrived at a true optimum combination.

Certain factors make this selection a difficult one. Primary among these is the variation in historical power demand and other quantities that affect power costs. These variations tend to invalidate selections based on other than current values.

An improvement was gained by using a computer to exhaustively evaluate all possibilities for assigning pumping loads. The essential feature was a logical search procedure for examining every combination scheme which would develop the required throughput in the system.

Electric cost. The computer determined the electrical power cost for each such scheme and the least expensive was chosen as optimum. The method, as applied to the Ozark System, provided a guaranteed optimum assignment but required excessive computing time for execution. Nevertheless, the feasibility of applying automatic computation to this problem of selection had been demonstrated.

The computer approach served a valuable purpose because it forced a definition of line characteristics in terms suitable for computer utilization.

To stimulate the line, the program was required to contain an exact duplication of the principal features of the system to achieve the desired accuracy of analysis.

Among such features included are: the usual parameters of interstation lengths, diameter, and elevations at station locations and at other controlling points. Pumps were represented by individual head-capacity curves, Fig. 2.

Equations set. The program preceded more formal methods of selection and further provided the opportunity to place those relationships that govern line operation on concise form. For example, the terminology encountered in a typical high-voltage service power contract was reduced to a brief set of equations similar to the following:

$$B\ (\$) = \text{max.}\ (B_d + B_e, k_1 D, k_2)$$

Where:

$$\begin{aligned} B_d &= a_1 D + b_1 \text{ for } 0 \leqq D < c_1 \\ &= a_2 D + b_2 \text{ for } c_1 \leqq D < c_2 \\ &= a_3 D + b_3 \text{ for } c_2 \leqq D \end{aligned}$$

and

$$\begin{aligned} B_e &= a_4 E + b_4 \text{ for } 0 \leqq E < c_3 \\ &= a_5 E + b_5 \text{ for } c_3 \leqq E < c_4 \\ &= a_6 E + b_6 \text{ for } c_4 \leqq E \end{aligned}$$

Here, B represents the total power bill incurred for a maximum deman, D, set for the pumping period. E is the energy used during that period. Constants, k_1, k_2, a_1, b_1, c_1, a_2, b_2, c_2, etc., are defined by the terms of the contract. The above equations were easily translated to the sequence of computer operation necessary to find B.

The New Method

It appeared that use of computer-based optimization could be made profitable in view of the success of techniques collectively denoted "mathematical programing" in other sectors of the oil industry.

Included among such methods are those of linear and nonlinear programing, which have been extensively applied to the problem of process optimization.

A multistage allocation procedure was decided on after examination of several such techniques. This decision was based on the fact that the procedure is direct and flexible enough for application to most pipelines of the Shell system without modification, in addition to being relatively conservative of machine time.

Values assigned. The procedure will assign values to materials and labor required at each stage so that cost is minimized or profit maximized for the entire process. The basic rule for making the assignment is that allocation at each stage must be optimum with regard to that made at previous stages.

The allocation procedure may be briefly outlined as follows:

The first two stations on the line initially are considered as one with regard to pressure generation. A selection is made of that portion of the pressure each station develops so that the sum of the costs for both stations is a minimum for each value of total pressure put up by these stations.

The selection is made over the entire range of pressures permitted by line hydraulic restrictions. The

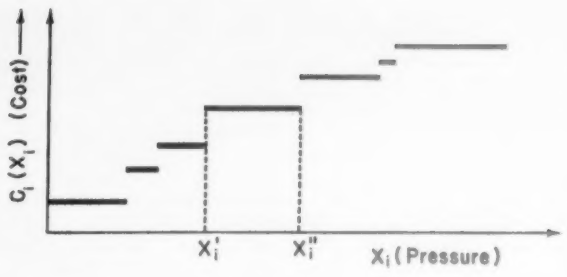

Fig. 3.

EFFECTIVE USE of a formal mathematical technique such as multistage allocation requires that the reltaionships between variables be as simple and well defined as possible. For example, the restriction to constant flow rate and uniform crude assures that there will be only one value of cost associated with each value of pressure developed at a station. This "uniqueness" requirement must be met if the allocation method described in the text is to be applied.

Under the restrictions imposed, the cost-vs.-pressure relationship takes a fairly simple form. A typical such relationship for a station with constant speed centrifugal pumps is shown. This "step function" owes its form to the fact that pressures are available, for practical purposes, only in discrete values. These are at the right-hand side of each "step."

In the figure, X_i' and X_i'' schematically represent two such adjacent values, each being the differential pressure developed by an available combination of pumps at that station. Although the effective station pressure X_i may take any value between X_i' and X_i'', such an intermediate value is obtained only by throttling back the required amount from X_i''.

This waste of energy is avoided in practice unless there is danger of violating pressure tolerances. Thus, the differential pressure required, and hence cost incurred, in developing any station pressure between two such discrete values is constant and equal to that required for the greater of the two.

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results will be a cost versus pressure-developed relationship similar to that for one station. With these two stations considered as a unit, the combination of these and the third station on the line is treated in the same manner.

Pressure related. The result will again be an "optimum" assignment of pressure developed by each of the three stations for each value of the total pressure developed by the three. The process is continued until all stations on the line have been considered.

Some assumptions must be made to represent the physical characteristics of a pipeline in terms suitable for mathematical programing. We will assume that the material being allocated is pressure at each station, that throughput is constant during the pumping period, and that the crude being pumped is uniform with respect to viscosity and gravity.

These restrictions insure that pressure at each station can take only a limited number of discrete values (one for each pump combination), and that a definite cost may be assigned to each such value, Fig. 3.

No injections or stripping, unless of negligible effect, are provided for. Nor, generally, is anything provided that jeopardizes the program's ability to express line hydraulic requirements and restrictions as constant values.

Restrictions limiting. The restrictions may seem severe, although they are not when seen in the light of current engineering practice. The question may justifiably be raised as to whether the assumptions made would invalidate the selections under certain conditions, such as where crudes of widely differing viscosities are batched in a common slate.

This situation implies generally a significant variation in throughput during the pumping cycle, dependent on the sizes of the heavy tenders, their viscosities, and the portion of time that those batches are in the line.

Power requirements and hence optimum power allocation ideally would have to be specified over very small intervals of time, inasmuch as energy requirements of a line change with changes in line inventory for a line carrying multitender crude slate.

Complications, primarily those introduced by the demand factor in electrical-utility rate schedules, prevent this full optimization from being merely a matter of running a multistage allocation for, say, each hour of a projected month's operation.

Settings impractical. A detailed specification of power-level settings, even if available, would very likely be disqualified by numerous practical considerations that affect line operation yet cannot be provided for in a limited analytical treatment such as the one under discussion.

For this reason, the assumption thus far has been made that individual batch viscosities are reducible to an "equivalent viscosity" for the entire crude slate, and that gravities may be considered likewise.

Future Program Additions

Some utility companies offer discounts to users for keeping demand levels of usage constant. This discount may, for instance, be figured on the basis of how many months of the previous year set demand levels have been within a specified range.

Also, some recognition must be made of anticipated future energy requirements because failure to effectively utilize set demands penalizes the user.

Current study indicates that the problem can be resolved by a refinement of the multistage allocation method. The procedure is essentially as follows:

A period of time is picked to cover the desired future throughput fluctuations and an arbitrary maximum electrical demand is chosen to be set at each station for entire period.

Monthly allocations. A multistage allocation is performed for each month of the period, with costs at each station set arbitrarily high for those pressures that give demand levels about the preset maximum.

The total power cost for the entire period is computed, and the maximum set demands revised upwards or downwards according to whether they are fully utilized at the station or not.

The optimum allocation for each

month is again derived, the cost again computed, and a comparison between this cost and the one previously calculated used to determine the next revision of maximum permissible demand levels. The process is continued until no further change in these levels is indicated.

The result is a set of demand values that serve as additional restrictions on the range of pressures available at each station. An optimum allocation of units that observes these restrictions is then the best obtainable with recognition of historical and anticipated future demands.

Conclusion

There is little doubt that mathematical programing methods can furnish a systematic approach to optimization problems of great variety. It should not be inferred from the preceding discussion that these methods lack generality.

It is hoped that, through development and study, the limited function performed by the basic program described may be extended to provide for all significant factors influencing the operation of the typical major trunk line.

Such an extension will result in increased ability to predict operating costs and to exercise control of the many variables that influence these costs.

Acknowledgment is given H. L. Sellers, Houston Research Lab. at the Shell Oil Co., Houston refinery, for suggesting the method of multistage allocation and developing its application to power-cost optimization.

. . . here's how dynamic programing functions

Detailed description of the allocation method

HERE IS THE WAY an analytical statement of the pump-combination selection problem is developed. It is followed by a brief outline of the multistage allocation process.

The assumption is made that liquid flow rate is constant over the desired period of optimum allocation, and that the crude oil is uniform with respect to viscosity and gravity. Energy costs are assumed, in general, to be different for each station.

The variables over which minimization of cost is obtained are the pressure boosts, or differential pressures, at each pumping station. The expenditure at a given station is determined by the differential pressure developed at that station because energy required is proportional to the product of pressure and flow rate, and flow rate is constant for our purposes.

Consider first a pipeline consisting of two stations and a terminal Fig. 4. Each station is associated with an elevation, a distance in equivalent length of pipe of given inside diameter from the first station, a maximum permissible discharge pressure, and a minimum permissible suction pressure.

For the i'th station, these will be denoted respectively by E_i, L_i, P_i^d, P_i^s. Suction pressure at the first station and required tank head at the terminal are considered invariable, and are represented by P_o^s and P_N^s.

Pressure drop. The heavy line connecting the stations of Fig. 4 is a plot of pressure versus distance (the hydraulic gradient) along the pipe. The line's slope is proportional to the loss of pressure per unit length of pipe due to frictional effects. The loss, usually expressed as pressure drop per mile, is a function of flow rate, crude viscosity and gravity, and the given inside diameter of the pipe. This pressure drop will be denoted by ΔP.

Letting X_i be the differential pressure at the i'th station, the restriction that discharge pressure at the first station must be less than maximum permissible discharge at that station may be written as:

$P_o^s + X_1 \leqq P_1^d$, or $X_1 \leqq P_1^d - P_o^s$.

The total pressure drop between two stations, say the i'th and $(i-1)$th, is the sum of two factors: the frictional loss, $\Delta P\ (L_i - L_{i-1})$, and that loss incurred in overcoming static disadvantage, $k(E_i - E_{i-1})$, where k converts feet of head to psi. for the crude involved.

The fact that suction pressure at the second station must be at least P_2^s is expressed by:

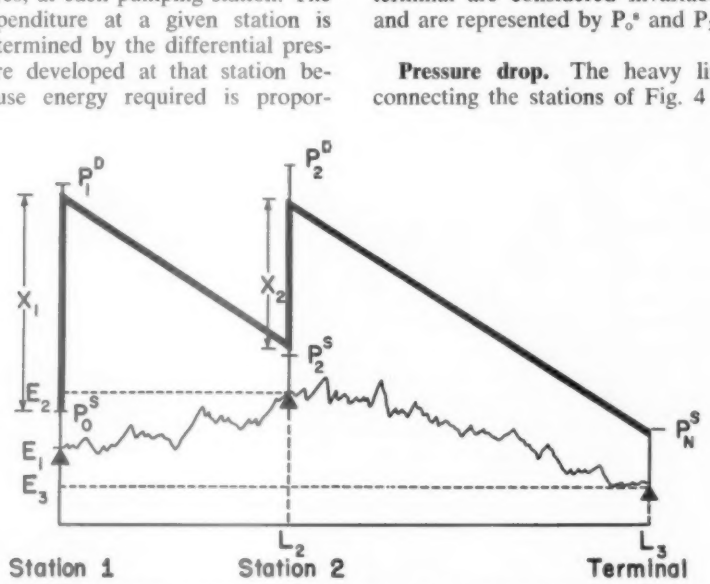
$$P_o^s + X_1 - \Delta P\,(L_2 - L_1) - k(E_2 - E_1) \leqq P_2^s$$

$$\text{or } X_1 \leqq P_2^s - P_o^s + \Delta P(L_2 - L_1) + k(E_2 - E_1).$$

Since discharge pressure at the second station must be less than P_2^d:

$$P_o^s + X_1 - \Delta P(L_2 - L_1) - k(E_2 - E_1) + X_2 \leqq P_2^d$$

$$\text{or } X_1 + X_2 \leqq P_2^d - P_o^s + \Delta P(L_2 - L_1) + k(E_2 - E_1),$$



THE HEAVY LINE plots the hydraulic gradient along the pipe. Its slope is proportional to the loss of pressure per unit length of pipe due to frictional effects. Fig. 4.

but must be great enough so that suction pressure at the terminal is at least equal to tank head, P_N^s:

$$P_o^s + X_1 - \Delta P(L_2 - L_1) - k(E_2 - E_1) + X_2 - \Delta P(L_3 - L_2) - k(E_3 - E_2) \leqq P_N^s$$

$$\text{or } X_1 + X_2 \leqq P_N^s - P_o^s + \Delta P(L_2 - L_1) + k(E_2 - E_1) + \Delta P(L_3 - L_2) + k(E_3 - E_2).$$

Setting $B_1 = P_1^d - P_o^s$; $A_1 = P_2^s - P_o^s + \Delta P(L_2 - L_1) + k(E_2 - E_1)$; $B_2 = P_2^d - P_o^s + \Delta P(L_2 - L_1) + k(E_2 - E_1)$; $A_2 = P_N^s - P_o^s + \Delta P(L_2 - L_1)$ $k(E_2 - E_1) + \Delta P(L_3 - L_2) + k(E_3 - E_2)$; we may write recursively:

$$B_2 = B_1 - P_1^d + P_2^d + \Delta P(L_2 - L_1) + k(E_2 - E_1)$$
$$A_2 = A_1 - P_2^s + P_N^s \Delta P(L_3 - L_2) + k(E_3 - E_2).$$

For the general case of a line with an arbitrary number of pumping stations, say *n*, the above relationships become:

$$A_i = A_{i-1} - P_i^s + P_{i+1}^s + \Delta P(L_{i+1} - L_i) + k(E_{i+1} - E_i)$$
$$B_i = B_{i-1} - P_i^d - 1 + \Delta P(L_i - L_{i-1}) + k(E_i - E_{i-1})$$

The system of inequalities

$$\begin{aligned} A_1 &\leqq X_1 \leqq B_1 \\ A_2 &\leqq X_1 + X_2 \leqq B_2 \\ A_i &\leqq X_1 + X_2 + \ldots X_i \leqq B_i \\ A_n &\leqq X_1 + X_2 + \ldots + X_n \leqq B_n \end{aligned} \quad (1)$$

then defines completely the hydraulic requirements of the pipeline and the range within which the X_i may vary for consideration of the energy costs.

At this point, the form of the constraint relations (1) may suggest the application of a linear or nonlinear programing method. Complications, however, prevent the use of these methods without modification.

First, cost as a function of energy consumed under our assumptions is not a smooth curve (i.e., the derivative of cost generally has several discontinuities over the range of interest).

Second, the variables X_i are in themselves discontinuous, as implied by the physical system: pumps on large-diameter trunk lines are generally of the constant-speed type, required pressure variation ranges being obtained by utilizing different combinations of pumping units. As a result, pressures are available for practical purposes only in discrete values.

The cost versus pressure relationship for a given station must then take the form of a step function, such as Fig. 3.

Denoting this cost as a function of pressure for the *i*'th station as $c_i(X_i)$, the original problem may now be stated as that of minimizing

$$C = c_1(X_1) + c_2(X_2) + \ldots + c_n(X_n)$$

subject to constraints on the variables X_i as defined by Equations 1.

Optimal policy. The multistage allocation process is one of several methods that fall under the heading of "dynamic programing."

A basic premise of dynamic programing is the **principle of optimality:** An optimal policy* has the property that, whatever the initial decision, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first policy.

With this consideration in mind, the application of the multistage allocation process to the problem may be described briefly as follows:

Consider first a line of two stations, with constraint relations

$$\begin{aligned} A_1 &\leqq X_1 \leqq B_1 \\ A_2 &\leqq X_1 \leqq B_2 \end{aligned} \quad (2)$$

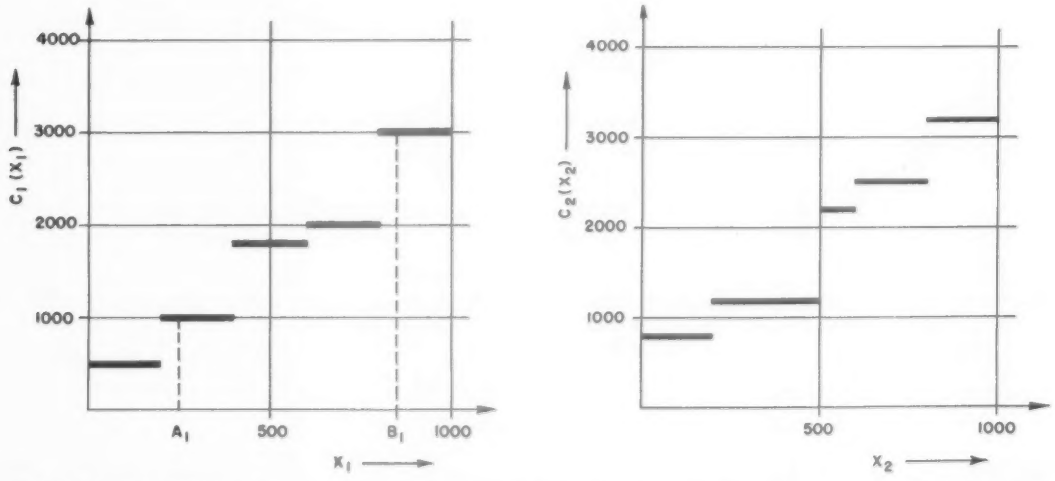
and cost functions of the form:

for $0 \leqq X_1 \leqq a_1$ $c_1(X_1) = c_1$
$a_1 \leqq X_1 \leqq a_2$ c_2
$a_2 \leqq X_1 \leqq a_3$ c_3
$a_i \leqq X_2 \leqq a_{i+1}$ c_i

*Meaning here a procedure or set of rules for assigning optimum power levels.

and similarly for $c_2(X_2)$. These are illustrated for a relatively simple case by Figs. 5 and 6. It is seen that both stations whose cost versus pressure relationships are depicted here have five available pump combinations.

The objective is finding values of X_1 and X_2 satisfying Equations 2 such that $c_1(X_1) + c_2(X_2)$ is a minimum.



EACH OF THESE STATIONS whose cost versus pressure relationships are depicted, has five available pump combinations. Application of the multistage allocation process determines which, in relation to cost, is optimal. Figs. 5 and 6.

Setting $X_1 + X_2 = S_2$, the observation is first made that for each value of S_2 such that $A_2 \leqq S_2 \leqq B_2$, there are an infinite number of combinations of values of X_1 and X_2 whose sum is equal to S_2. However, due to the step function nature of $c_1 (X_1)$ and $c_2 (X_2)$, there are only a finite number of (discrete) cost values.

Cost vs. pressure. Suppose now that for each value of S_2 between A_2 and B_2 we assign the minimum of all possible values of the cost function $c_1 (X_1) + c_2 (X_2)$ for that value of S_2. In this manner, another step function, such as Fig. 7, is obtained, relating minimum cost $C (S_2)$ to total pressure developed.

(Figs. 5, 6, and 7 are drawn to scale; the step function of Fig. 7 does, in fact, represent a minimum cost for the total pressure developed by the stations whose cost versus pressure functions are given by Figs. 5 and 6. For example, the minimum possible cost for a total of 1,200 psi. developed by stations 1 and 2 is $3,200. This corresponds to pressures of 800 psi. and 400 psi. for stations 1 and 2, respectively.)

For the two-station case, the minimum cost associated with operating the line may now be read off as the value of $C (S_2)$ corresponding with $S_2 = A_2$.

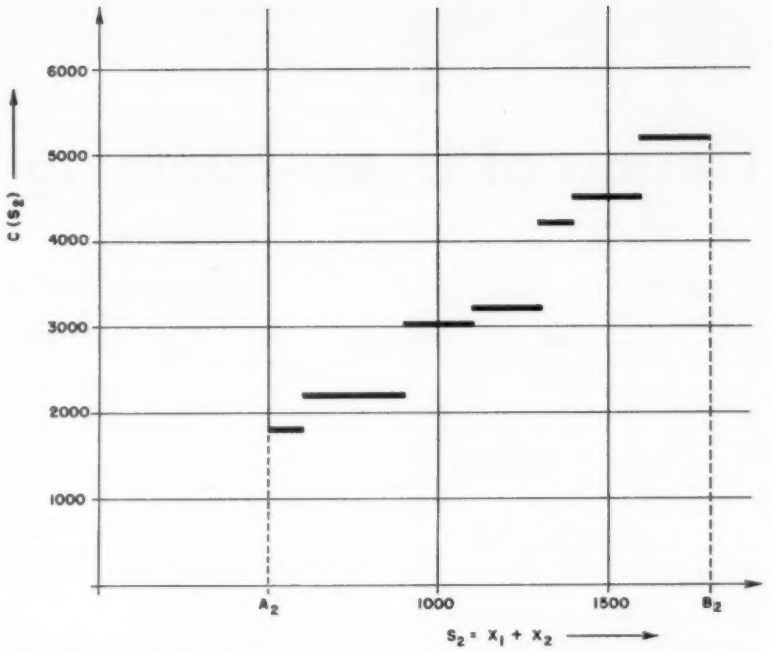
By extending the process to the case of three stations the nature of the general procedure becomes evident. For this purpose, the first two stations will be considered as one, with total pressure developed equal to S_2 and associated cost the minimum cost, $C (S_2)$ for each value of S_2. The system now takes the aspects of a two-station system as before, with restraints:

$$A_2 \leqq S_2 \leqq B_2$$
$$A_3 \leqq S_2 + X_3 \leqq B_3 \qquad (3)$$

and cost function $C (S_2) + c_3 (X_3)$.

Setting $S_3 = S_2 + X_3$, we may again plot the minimum cost, $C (S_3)$ for each possible value of S_3 subject to Equations 3, considering the first two stations a single station, and obtaining as a result a step function similar to that obtained for the two station case.

Total pressure. This process is continued, finding the minimum cost associated with operating a given number of stations as a function of total pressure developed at those stations, and adding one more station each time until the end of the line is reached. For an n-station line, the final result is a step function; $C (S_n)$, relating minimum cost to pressure for the line.



THE MINIMUM COST for the total pressure developed by the stations whose cost versus pressure functions are shown in Figs. 5 and 6 are represented by the step function shown here. It shows, for example, that the minimum cost for a total of 1,200 psi. developed by these stations is $3,200. Fig. 7.

The above may be stated more concisely in terms of the original formulation by Bellman[1]. For the allocation at the first stage:

$$\text{Min.}$$
$$C (S_2) = A_1 \leqq (S_2 - X_2) \leqq B_1$$
$$[C_1 (S_2 - X_2) + C_2 (X_2)].$$

In the context of the general problem of allocation of resources, $C (S_2)$ is the minimum cost associated with the optimal split of total resources S_2 for the first two stages of the process between $S_2 - X_2$ and X_2, with $S_2 - X_2 \ (= X_1)$ constrained to lie between A_1 and B_1. At the end of the second stage, the relationship becomes:

$$\text{Min.}$$
$$C (S_3) = A_2 \leqq (S_B - X_3) \leqq B_2$$
$$[C (S_3 - X_3) + C_3 (X_3)],$$

and in general:

$$\text{Min.}$$
$$C (S_i) = A_{i-1} \leqq (S_i - X_i) \leqq B_{i-1}$$
$$[C (S_i - X_i) + C_i (X_i)].$$

It should be noted that at the end of each stage *i*, the process yields X_i as a function of S_i, i.e. corresponding to each value of S_i there is a value of X_i which minimizes the cost. If this funtcion is denoted as $X_i = f_i (S_i)$, and remembering that $X_i = S_i - S_{i-1}$, then individual optimum pressures at each station are obtained by calculating backwards in the following manner:

If S_n is set equal to B_n, the minimum total pressure needed to meet the hydraulic requirements of the line, then

$$X_n = f_n (S_n)$$
$$S_{n-1} = S_n - X_n$$
$$X_{n-1} = f_{n-1} (S_{n-1})$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$S_2 = S_3 - X_3$$
$$X_2 = f_2 (S_2)$$
$$X_1 = S_2 - X_2.$$

Reference

1. Dynamic Programming, by R. Bellman, Princeton University Press, Princeton, N. J., 1957.

Design of beam-pumping installations

BY JOSEPH ZABA

TO "DESIGN" a beam-pumping installation means to select, for a given set of well conditions, both subsurface and surface equipment which will require a minimum of investment and will assure low operating cost, while furnishing the desired production. The starting points of design are the "given data" which consist usually of information on amount of production to be handled, depth from which fluid is to be lifted and fluid characteristics.

These data may be secured in one of several ways on a well which stops flowing and is about to be "put on pump." The number of barrels of fluid which the well is able to produce and the corresponding fluid levels may be determined from the history of the well itself. Data on offset wells already on mechanical lift may be used, as may bottom-hole pressure or fluid-level surveys. Tests with a temporary pumping unit can be made before permanent installation is designed. This last method is, of course, most satisfactory since it furnishes direct information on the loads and volumes of the installation. However, because of the cost involved it is used seldom in actual field practice.

Assuming that the installation has to be designed from given data, the method used is that of trial and error. Certain assumptions are made followed by the necessary calculations. The results are then checked to determine whether or not the components of the installation are within their load capacities while furnishing the needed production. If this is not the case new assumptions are made and the calculations repeated.

It would appear that this procedure involves much work and many calculations. This is true. But for assumed combinations of certain data, complex formulas reduce themselves to rather simple equations.

To illustrate, suppose that 300 bbl. of fluid is to be lifted per day from 4,500 ft. Assume that the fluid has a specific gravity of one. Tubing will be anchored and ¾-in. rods have been selected, although this would not be the final selection. Coberly's formula for plunger for maximum production will be used (Part 25). For these assumptions the formula is:

$$\text{Plunger area} = \frac{\text{pol.-rod stroke} \times \text{modulus of elasticity} \times \text{rod area}}{10.39 \times \text{sp. gr.} \times (\text{pumping depth})^2}$$

$$= 0.063 \times \text{pol.-rod stroke}$$

Similarly, the correction factor of this formula for overtravel would reduce itself, for the assumptions made, to: Factor $= 1 + 0.00048\ (\text{s.p.m.})^2$. Calculation of plunger sizes, even for a number of different stroke and speed combinations, would be quite simple. Furthermore, if one of the combinations is assumed and others are worked out, certain terms repeat themselves and do not have to be calculated each time. Those who are frequently engaged in this type of calculations develop different short cuts in form of tables and charts to further facilitate and speed up the work. Manufacturers furnish guides for design in form of charts and tables. Special slide rules are available for certain portions of the design procedure.

Design procedure. Many different design approaches are used. The variations include differences in types of assumptions made, modifications of the formulas used, and changes in sequence of the individual steps of design. All these methods, however, have one thing in common. The installation is considered as a unit, from the bottom-hole pump to the surface prime mover. This is necessary because of the interdependence of action of the components and because economics dictate that no part of the system should be oversized in capacity in relation to other parts.

One of several possible methods of design is given in the following outline of procedure:

Step 1. A tentative selection is made of the pumping-unit size for the volume to be lifted and depth of pumping. Such selection may be based on experience or may be taken from a chart prepared for such an approximate selection. Some of these charts have been published.[1] The selected unit determines the available lengths of stroke and suggests the rods to be used. Once the allowable rod stresses are decided upon there is, for each plunger size, each depth-volume bracket, and each unit, a string of sucker rods of fixed type and size, or combination of sizes, which is the lightest and most economical.

These combinations once worked out may be used in routine design for the first tentative selection of the rods needed.

Step 2. The size of the plunger determines the loads, the design of rod string and size of the surface equipment. The smallest plunger capable of furnishing the expected production is wanted (Part 25). For given lengths of stroke and assumed speeds of pumping, plunger sizes for maximum production can be calculated with Coberly's formula (Part 25). In assuming the speeds of operation the question of synchronous speeds should be considered (Part 5) together with depth of pumping and well characteristics (Part 26).

Step 3. For different combinations of available strokes, assumed speeds, and calculated plunger sizes, the pump displacement is calculated (Part 25). For the displacement approaching the desired production the sucker-rod string is designed for the rods tentatively selected in Step 1 (Parts 20 and 21). Peak polished-rod load is determined with one of the formulas available for this purpose (Part 7).

Step 4. Actual plunger travel and actual pump displacement for the assumed volumetric pump efficiency are calculated (Parts 22 to 25 inclusive). If a tapered string of rods is used and if design was based on equal stresses in top of each portion of the string, check is made whether or not the allowable rod stresses have been exceeded. Check is also made of the range of loads of the rods. At this point new assumptions may have to be made and the installation recalculated either because the actual pump displacement does not furnish the desired production or because the rod string does not meet the load requirements.

Step 5. Counterbalance requirements and peak torque are calculated (Parts 8 and 9). Check is then made whether or not the unit tentatively selected meets the requirements of peak load, counterbalance and capacity, and peak torque. Here again new assumptions may have to be made and the installation recalculated. Additional check can be made through torque-factor analysis (Part 35). This would determine also the unit with most favorable geometrical layout.

Step 6. Power requirements of the installation are determined (Part 10), appropriate prime mover selected (Parts 37, 38, and 39), and V-belt drive is designed (Part 36).

As already mentioned in this series, several studies are now in progress on use of analogs and digital computers in design of beam-pumping installations. These studies may result in quicker and more accurate methods of design than the ones now used. Until results of these studies are made public and until these results are supported by actual field use, the method outlined above, or any one of the possible variations, furnishes a reasonably satisfactory basis of design.

Check of design. Because the formulas used here are only approximate, there is a need for check of the installation with appropriate instruments, after it has been put in operation. Need for such a check may occur in many instances later in the producing life of the well, when abnormally frequent mechanical difficulties with the well's pumping equipment suggest that changed well conditions may require changes in the original design. The instrument most frequently used for this purpose is the dynamometer. The use of dynamometer for diagnosing the most common well difficulties and for determining the basic parameters affecting the performance of the pumping system has been already discussed in several preceding installments. More detailed analysis of dynamometer cards to diagnose special problems is a subject in itself and is beyond the scope of this series.

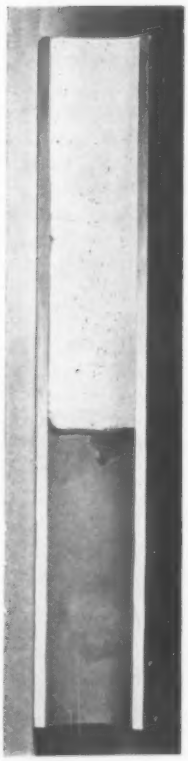
Reference

1. R. E. Higgs and B. G. Agnew, "Method of Establishing Pumping Unit Requirements": Drilling and Production Practice, API, 1958, p. 158.

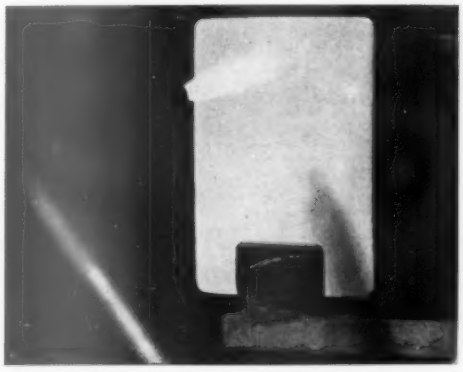
Process industries get new construction material

A CERAMIC-METAL composite consisting of a unique crystallized glass structure physically and chemically bonded to a structural metal has been developed by Pfaudler Division of Pfaudler Permutit, Inc. Compared to conventional ceramic-metals, considerable resistance to damage by impact and thermal shock has been added, while the inherent corrosion resistance of the ceramic surface has been extended into high-temperature ranges never before possible.

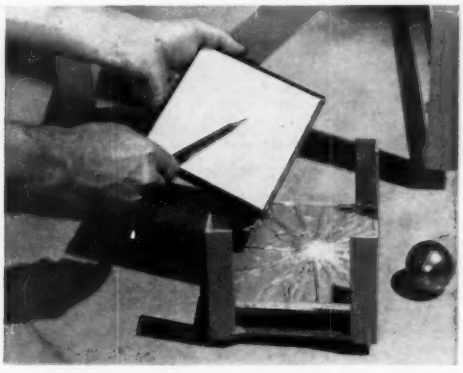
Controlled laboratory tests point up these properties:



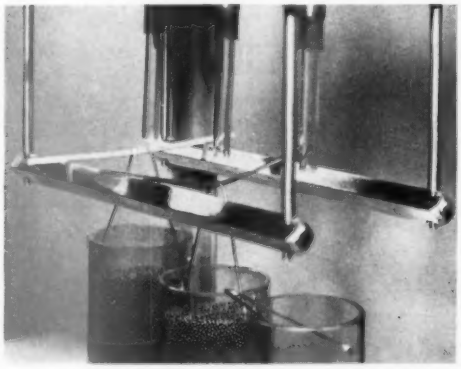
1. **Corrosion resistance.** Resists corrosive vapor attack at 1,200° F.



2. **High-temperature stability.** Protects base metal from oxidation for 5 minutes at 1,600° F. temperature.

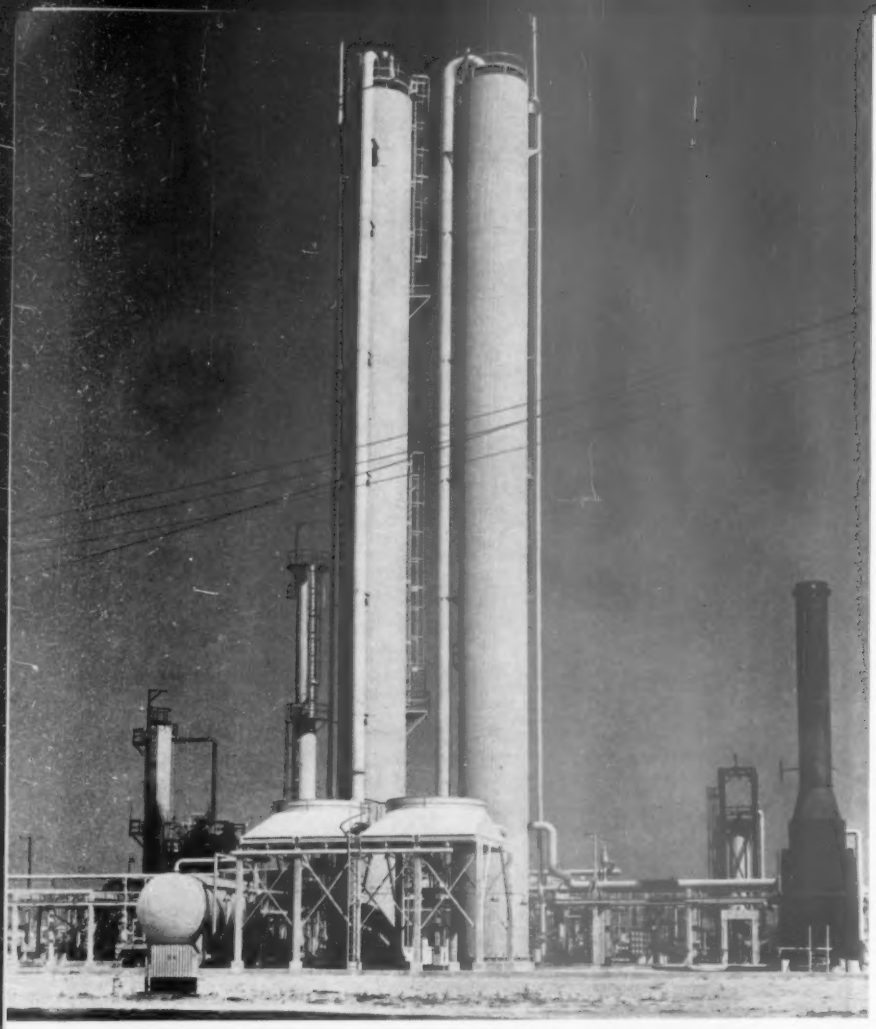


3. **Impact strength.** Eighteen times the point-of-impact force needed to shatter safety glass leaves only minor surface crush on this material.

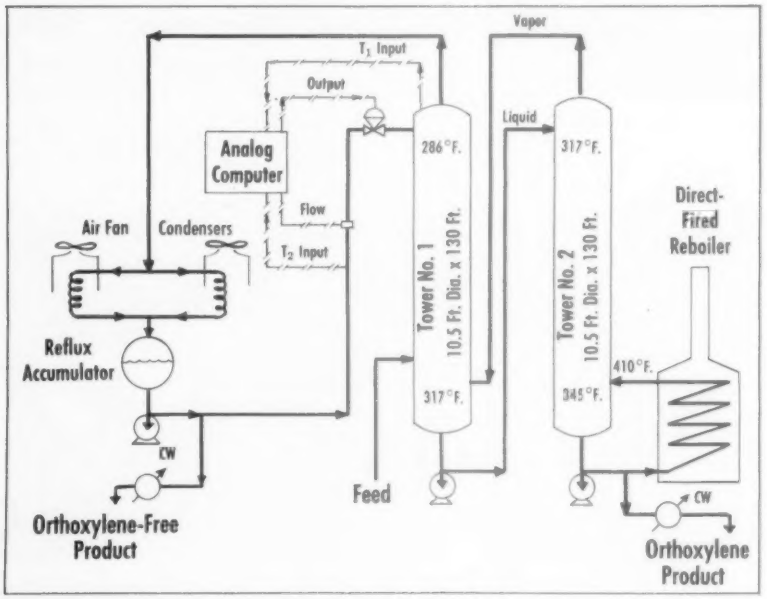


4. **Tensile strength.** A rod of the ceramic component withstands 85,000 psi. without damage while metal rod under equal stress is permanently deformed.

5. **Thermal shock.** Takes a temperature differential of 1,200° F. — three to four times better than existing glassed metals are able to perform under similar tests.



DIRECT-FIRED REBOILER (right) and reflux accumulator (left) flank twin 130-ft.-tall aluminum insulated towers at Delhi-Taylor's orthoxylene unit. Air-fan condensers condense overhead product.



COMPUTER-CONTROLLED internal reflux maximizes orthoxylene production from a narrow-range mixed xylene feed stream.

Computer controls the reflux rate on orthoxylene tower

BY H. C. BOZEMAN
Gulf Coast Refining Editor

INSTRUMENTATION and ease of control key successful orthoxylene-unit operation at Delhi-Taylor Oil Corp.'s Corpus Christi, Tex., refinery.

An analog computer exercises closed-loop computer control of internal reflux in the orthoxylene tower. Operators use a chromatograph to monitor product qualities.

The unit separates 36 million pounds yearly of orthoxylene from a mixed-feed stream. Separation is done in a 260-ft. tower that for construction reasons is built in two 130-ft. sections.

Feed, a 5° F. xylene stream, is prefractionated in one of the refinery's other units.

Delhi-Taylor modified a Universal Oil Products Co. design, built the unit in 6 months, and engineered it for ease of control and operation. Here are some construction features in addition to the analog computer and chromatograph.

- Air-fan condensers condense overhead product.
- Crossflow sieve trays in the towers.
- Oversize and insulated reflux accumulator.
- Direct-fired reboiler.
- Vertical pumps for reflux.

Process Flow

The unit separates orthoxylene

Unit operators use chromatograph to monitor product qualities

from a mixture of ortho, meta, and paraxylene and ethylbenzene. Feed stream from the refinery's Udex unit is prefractionated and the overhead product sent to the orthoxylene unit. Purchased stock is run directly from storage to the ortho tower.

Separation is done in a split-tower fractionator. Orthoxylene product collects at the bottom of the No. 2 tower and an essentially free orthoxylene stream is condensed from the top of No. 1 tower.

Each tower is 10.5 ft. in diameter, 130 ft. tall, and has 60 cross-flow sieve trays.

Close boiling points of feed components require many trays for good separation, hence the split-tower design.

Instrumentation

The computer calculates the amount of external reflux necessary to maintain constant internal reflux conditions in the tower. Computer inputs are two temperatures for a differential temperature and one flow measurement. Computer output adjusts the external reflux control valve as necessary.

Constant internal reflux is essential for smooth column control. Also, it helps maintain quality specifications, tray loading, and maximum orthoxylene recovery from the feed.

Unit operators use a laboratory-model chromatograph to monitor product qualities. An analysis requires about 15 minutes. The operators convert peak heights on the chromatograph analysis plot to per cent composition. Then, control conditions are adjusted manually.

Construction Features

Tower No. 1 overhead condensers are air-fan condensers. It is an ideal application for them, Delhi-Taylor says, because of the high condensing temperature (about 282° F.). Final cooling of overhead and bottoms streams is with cooling water.

Payout for the air-cooled condensers versus water condensers is realized from elimination of water-treating facilities and additional cooling-water tower.

Level control on the sieve trays is critical and formed the basis for installing computer control of internal reflux. Delhi-Taylor says it operates with exceptionally high tray efficiency.

Reflux accumulator is oversize and insulated to minimize the effect of temperature changes from weather conditions and other causes on external reflux temperature.

The reboiler for tower No. 2 is a direct-fired horizontal heater. It saved the installation of more steam generators and extension of steam lines to the unit.

Reflux to tower No. 2 is pumped by vertical pumps which eliminated the need for a support structure for the reflux accumulator.

Construction materials are carbon steel. Instruments other than temperature and computers are pneumatic. Pumps have mechanical seals. The unit is designed for versatility and, with piping changes, can be converted to other distillation uses.

Refinery Capacity at Sugar Creek

On Page 175 of the April 3 issue, The Oil and Gas Journal erroneously reported capacity of American Oil Co.'s Sugar Creek, Mo., refinery at 75,060 bbl. per calendar day. The first two figures were transposed and the correct capacity is 57,060 bbl. per calendar day.

New absorption-refrigeration gas-processing facilities with 30 M.M.c.f.d. capacity have recently been placed on stream near Medford, Okla., by Continental Oil Co. Initial product recovery totals 23,500 gal. daily of propane, butane, and natural gasoline from the $930,000 plant. The liquids are extracted from Oklahoma Natural Gas Co.'s gas line that supplies Ponca City, Conoco's Ponca City refinery, etc.

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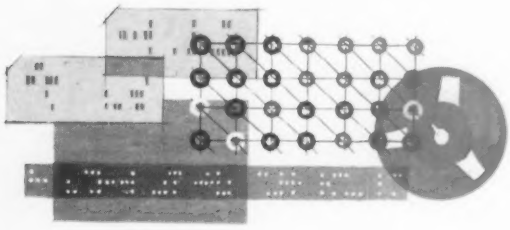

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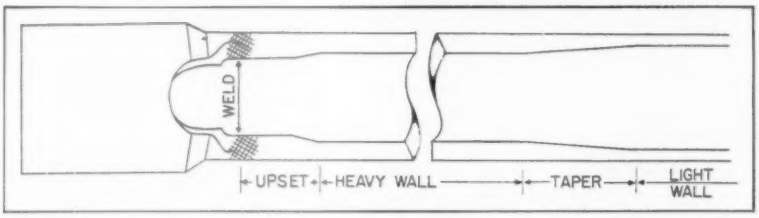
What's NEW . . . in equipment



DUAL-WEIGHT DRILL PIPE is designed to combine strength and light weight.

Dual-weight pipe cuts cost

A DUAL-WEIGHT steel drill pipe has been developed and is undergoing extensive field testing. The new type of steel drill pipe is expected to provide the weight-savings of lightweight pipe with the strength of regular drill pipe in all common API grades and sizes.

According to the developer, the pipe offers strength and service characteristics of regular seamless-steel drill pipe plus added performance and operating benefits. These include the ability of drillers to uprate rig-depth capacity, while retaining the same safety factor at the slips. Other expected benefits from the dual-weight pipe when compared with regular steel drill pipe include rigup with lighter power and pumping units, faster round trips, longer life from rigs and components, and lower drill-pipe transportation costs.

The larger inside diameter of the new pipe reportedly will permit movement of a greater volume of mud at higher velocities with equivalent pump pressures and with less frictional loss as compared with regular drill pipe.

Essentially, the new pipe is a seamless tube with two distinct wall thicknesses. Each length consists of an integral combination of a light-wall body and a heavier-wall box end. The heavy wall extends at least 4 ft. but not more than 6 ft. from the box end.

The heavy-wall end provides extra strength for the section of the pipe most vulnerable to crushing, bottlenecking, notching, and bending. This is the area that is subject to stresses applied by the slips, tongs, and elevators. The transition section between the heavy and the light-wall areas consists of a gradual and uniform internal taper of wall thickness. Externally, the pipe dimensions conform to API standards. Both ends are upset for application of API weld-on tool joints. Source: **Pittsburgh Steel Co., Grant Building, Pittsburgh 30, Pa., U.S.A.**

Need more facts on the items described on these pages?

The manufacturers will gladly supply them. They're shown, with their addresses in bold type. For convenience, send this coupon to the manufacturer.

ITEM _____

_____

OIL AND GAS JOURNAL

May 8, 1961

NAME _____

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Pillow-type tank handled by one man

A PORTABLE fabric tank made of finely woven nylon fabric impregnated with rubber can now be obtained in capacities from 60 to 350 gal. for storing fuel, oil, water, and other liquids. The tanks are relatively light weight; a 350-gal. tank weighs only 50 lb. when empty.

When the tank is empty, it can be rolled up and carried off to the next point of use or returned for refilling. These smaller sizes can be hauled on light trucks, flat bed trailers, or even sleds. Lift trucks can handle the tanks on skids for in-plant use.

The utility tanks are rugged enough to be loaded and unloaded in a sling when full. Source: **Goodyear Tire & Rubber Co., 1144 E. Market, Akron, Ohio, U.S.A.**

•

Unit detects pigs, spheres in gas or liquid pipelines

Accurate detection of pipeline spheres and pigs in both gas and liquid lines is claimed for a new detection unit, called a Mark IV Sphere Here. The device is pressure-balanced, built of stainless steel, and can be installed in any

position on pipe. It is designed to detect with equal response from either direction.

Factory tested to 3,250 psi., the device can be obtained with any of four accessories: (1) Microswitch, (2) visual indicator, (3) five-digit counter, (4) pneumatic pilot valve. According to the manufacturer, the unit is well suited for use on high-speed, displacement type of meter provers and can be installed at launching or receiving traps or at any desired intermediate point.

The unit is installed by drilling a 1¾-in. hole in the pipeline and then welding on a prescarfed base. If desired, a welding saddle or pad can be used. Source: **F. H. Maloney Co., P. O. Box 1777, Houston, Tex., U.S.A.**

●

Adhesive keeps surface casing from backing off

An epoxy adhesive with a breakout torque of over 7,000 lb.-ft. on a 2⅞-in. tubing joint has been developed. The Pipelock 924 adhesive was developed especially as a substitute for welding on surface casing joints to prevent the casing from backing off while being drilled through.

According to the manufacturer, the product joins and seals all steel pipe joints, hardens in a short time, and is resistant to high temperature, salt water, steam, and mud. It has been successfully field-tested in production wells.

Since it can be used to replace spot-welded connections on the bottom of joints of casing strings, it offers a way to reduce drilling costs by eliminating the need for welding time, labor, and equipment.

The product consists of a gray paste and a liquid hardener which are mixed together just before use. The two parts are prepackaged in the exact amounts to simplify field preparation. They can be blended at temperatures as low as 0° F. The mixture will stay soft and usable for about 40 minutes at 70° F. Source: **Shell Chemical Co., P. O. Box 831, Pittsburgh, Calif., U.S.A.**

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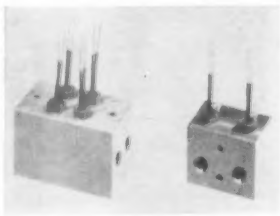

High performance claimed for thermal-conductivity detector

A new thermal-conductivity detector has been developed for gas chromatography, thermal-conductivity analyses, and other related applications designed to give high sensitivity and provide operation in any temperature range up to 930° F.

As described by the manufac-

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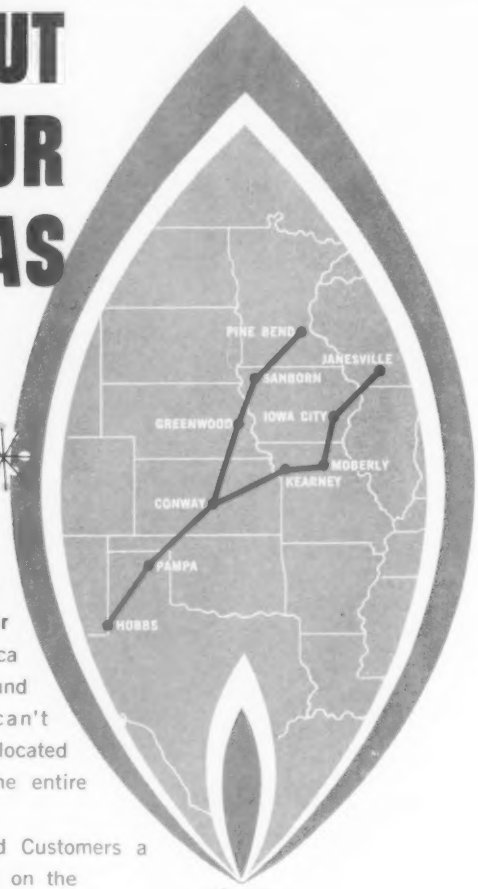

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turer, the unit is built to provide variable geometry. This is achieved by changing the type of element flow-shield.

Thermistor-element designs are available for operation to 572° F., tungsten-element detectors for a maximum temperature of 752° F., and iridium-element detectors for 932° F. Source: **Loe Engineering Co., 2092 N. Lincoln Ave., Altadena, Calif., U.S.A.**

●

New instrument speeds chart work

Manual chart averaging can be automated with a new instrument which is being put on the market. Called the UGC Chart Averager, the instrument continuously averages temperature, gravity, or pressure charts. The device is claimed to permit one operator to handle the entire job without comptometers or adding machines in one operation without the need for checking.

According to the developer, an operator can average a chart in 42 seconds with the device as compared to 225 seconds required for manual averaging. Source: **UGC Instruments, P. O. Box 1407, Shreveport, La., U.S.A.**

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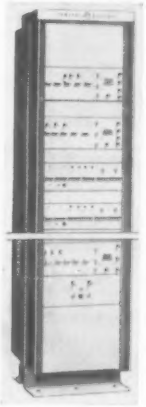
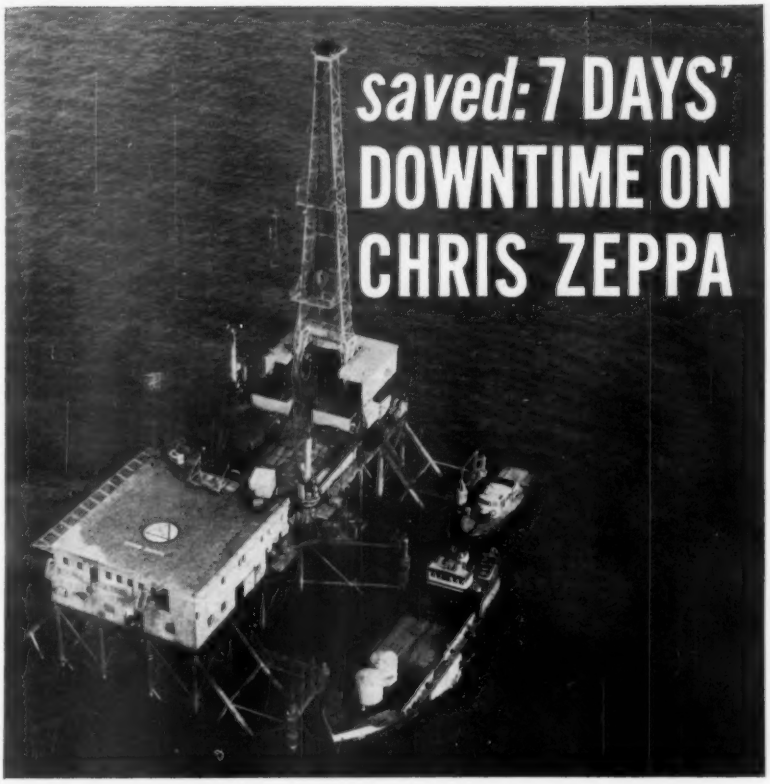
Microwave radio relay system boosts power output



A new transistorized microwave radio relay system is claimed to provide a tenfold increase in power output but to require 50% less power input than older systems. The new system is further claimed to virtually eliminate transmission errors and reduce maintenance considerably.

The RF-7 unit is



Drill barge recoated at lower cost, completed faster with CARBO ZINC 11

Delta Marine Drilling Company's submersible drilling barge, Chris Zeppa, returned to service one full week ahead of schedule following reconditioning and recoating with Carbo Zinc 11, Carboline's inorganic zinc coating. All areas subject to severe weathering and salt corrosion were protected—splash zone, structural supports and platform. Substantial savings were possible because:

1. Lower cost surface preparation. This is the first time an inorganic zinc coating was applied successfully on a submersible drilling barge over a commercial (rather than white) sandblasted surface.

2. No final curing solution required.

3. All weather application. No fear of delays due to adverse weather. Carbo Zinc 11 is water insoluble 20 minutes after application, can be applied in humidities up to 95% and temperatures as low as 0°F.

4. Outstanding resistance to salt environments. Resists undercutting and sub-film corrosion. Galvanic protection is long-lasting and dependable.

Foster Manning, division engineer of Delta Marine Drilling Co., described this new coating procedure as "successful and profitable—now adopted as a Delta Marine standard".

Write for technical information, suggested uses and sample panels on this unique coating.

carboline COMPANY

32-S Hanley Industrial Ct., St. Louis 17, Mo.

Sales engineers in principal cities. Consult your telephone directory.

MAINTENANCE COATINGS WITH EXPERIENCE

NOW!..FROM LINE SCALE...

REBUILT WEIGHT INDICATORS

One-half price (with trade-in)

No delay in shipping!

Save time . . . save money . . . with Line Scale's new "Trade and Save" plan for weight indicators! Trade in a usable case and frame from a Line Scale weight indicator and receive a rebuilt weight indicator of the same model for ONE-HALF PRICE! REBUILT INDICATORS CARRY A NEW WARRANTY! No delay in shipment . . . orders filled as they are received.

TRADE AND SAVE

Line Scale's Trade and Save plan means better service . . . more convenience . . . at *less cost* to you. Line Scale quality products are available at your favorite supply store.

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DIVISION
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EZY-VUE
PRESSURE GAUGE

THE FIRST ACCURATE PRESSURE GAUGE For Applications Requiring... RUGGEDNESS and DEPENDABILITY

CAPACITIES: 3,000, 5,000, 6,000, 10,000, 15,000 PSI Metric Equivalents Available.

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WRITE FOR DESCRIPTIVE LITERATURE
MARTIN-DECKER CORPORATION, DEPT. P-85
3431 CHERRY AVENUE, LONG BEACH 7, CALIF.

World's principal manufacturer of Oil Well Drilling Instrumentation

MOST USEFUL OIL FIELD TOOL

SIMPLEX EMERGENCY JACK No. 310A

- lifts, levels rigs; skids; moves machinery; pulls; positions; supports pipe; hundreds of other jobs
- 4-way lift power — on rotating cap; on auxiliary cap shoe (two positions); on serrated toe; at any point between with chain as sling
- lifts 15 tons, 14 inches high
- tilting base permits pushing or lifting at any angle
- double lever socket permits use in tight spots
- has handy carrying handle

GET COMPLETE FACTS,
Write for Catalog M-60

SIMPLEX RE-MO-TROL UTIL-A-TOOL JACKS JENNY ROL-TOG

TEMPLETON, KENLY & CO.
2539 Gardner Road
Broadview, Illinois

A. C. TEMPLETON, 5627 Del Roy Drive, Dallas, Texas.

built for high channel capacity and medium-to-long haul use. Transmiting at frequencies from 5,925 to 8,400 mc., the system can be used for services requiring from 1 to 600 telephone channels.

For remote alarm purposes, an optional alarm-control package is available that can monitor 100 remote stations and automatically ask each station 10 questions about remote functions. With the alarm control, a fail-safe method of integration is claimed to be built in. Source: **General Electric Co., Communication Products Dept., Lynchburg, Va., U.S.A.**

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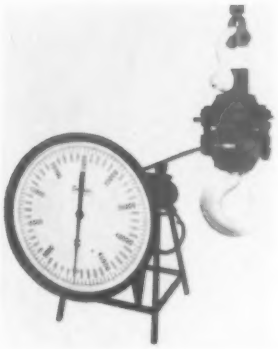


Crane scale lets operator read load easily

Using a new remote-indicating crane scale, an operator can read the dial at eye level while the load being weighed may be up to 100 ft. away, even out of sight. Made in capacity ranges from 500 to 60,000 lb., the crane-scale dials are calibrated in uniform increments using the complete dial circumference.

Made to conform to the accuracy specification of the Bureau of Standards, the scales incorporate such safety features as an ultimate strength of five times their rated capacity, and a dial crystal of shatter-resistant optic plastic. Source: **Martin-Decker Corp., 3431 Cherry Ave., Long Beach 7, Calif., U.S.A.**

•

Product lowers oil friction loss

Small quantities of a new oil friction-loss reducing agent now on the market, tradenamed J105, added to oil reduces the friction loss from 30 to 70%, the developer reports. In a recent test in a 6,000-ft. well with 2½-in. tubing pumping 32° API gravity crude oil at 10 bbl. per minute, the friction pressure reportedly was reduced from 3,600 psi. without the agent to 2,160 psi. with the agent.

As described by the developer, the product reduces friction loss by suppressing turbulence. It is expected to prove effective whenever the turbulent flow of oil is encountered. Source: **Dowell Division of The Dow Chemical Co., Box 536, Tulsa, Okla., U.S.A.**

Snubbers quiet equipment

Noise from engines, blowers, compressors, and vents can be reduced with a series of exhaust snubbers now on the market. Each of the components of the series is designed for a particular level of noise suppression.

For example, the Model BMA is designed for use in critical installations near residential and similar areas. The snubbers come in sizes from 8 to 30 in., pipe size. Source: **Burgess-Manning Co., 9207 Sovereign Row, Dallas, Tex., U.S.A.**

JENSEN'S NEW HI-COMPACT

saves you money 4 ways!

Check off the ways this newest of Jensen Rotary Balanced Jacks will save you money:

1. Uses much less concrete for the foundation.
2. Motor is well above ground, protected from dirt, grit and excess moisture.
3. Uses shorter, less expensive belts.
4. Easily and quickly converted to engine mount.

. . . PLUS . . . Jensen's famous one-man rotary counterbalance adjustment. Don't wait! Investigate!—NOW!

Stocked by Your Local Supply Store

Made by JENSEN BROS. MFG. CO., INC. P. O. Box 477-F, Coffeyville, Kans.

Export Office: 250 Park Avenue, New York 17, N. Y.

JENSEN—PACING THE OIL INDUSTRY SINCE 1919

JENSEN JACKS

The Most Efficient, High Pressure Valve Ever Made

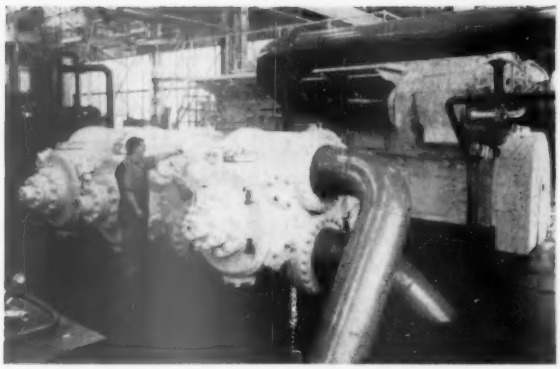
W-K-M BALANCED STEM GATE VALVE

The W-K-M Balanced Stem Gate Valve, built to control well pressures up to 20,000 psi, uses the unique and proved parallel-expanding gate principle. A balancing stem permits easy spin-open, spin-shut operation. Turning the handwheel exerts tremendous sealing force at both upstream and downstream seats with positive mechanical sealing in both open and closed positions. Superior performance on highest-pressure wells has made W-K-M Gate Valves the standard of excellence the world around. Futhermore, as added proof, this valve successfully completed "tests more severe than ever attempted on similar equipment" by an independent laboratory. For full information send for bulletin WP 1157 and a copy of "The Crookston Report." ... P. O. Box 2117, Houston 1, Texas.

When So Much Depends on a Valve... Specify W-K-M.

W-K-M DIVISION

ACF INDUSTRIES



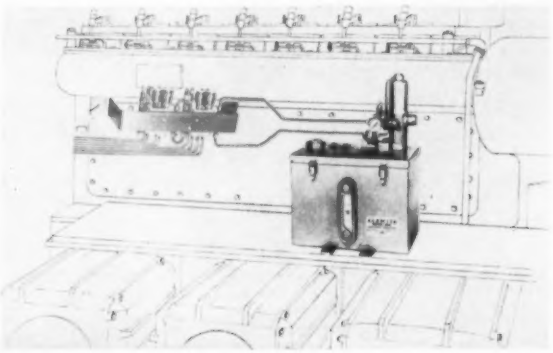
New cylinders feature cast-in headers

THROUGH the use of an "en bloc" construction, a new pipeline compressor cylinder has been developed with the headers cast directly into the cylinder body. This type of construction is expected to do away with pulsation problems arising from separate headers as well as from suction and discharge risers which act as resonators.

Both the suction and discharge headers open to the sides of the cylinders and are directly connected to the lead-in and leadout lines.

The new cylinder construction reportedly offers a number of advantages. It does away with the need for large external suction or discharge headers and suction and discharge nozzles between the cylinder and a conventional header. Compression losses are expected to be considerably reduced as the valves open directly into the suction and discharge-header areas.

The new cylinder is air-cooled and designed for high-volume, low-compression - ratio service. Source: **Clark Bros. Co., Olean, N. Y., U.S.A.**



System lubricates unattended equipment

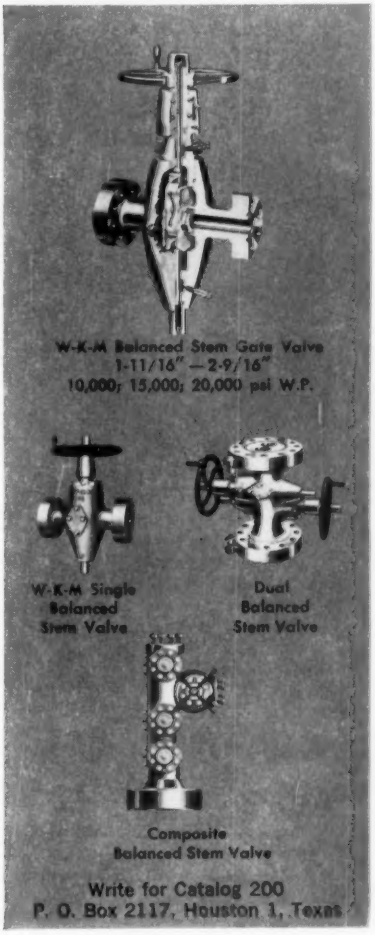
MULTIPLE BEARING POINTS on either attended or unattended equipment can be kept lubricated with a new centralized lubrication system now being produced for gas and process compressors, large diesel engines, and other heavy industrial equipment like turbines and pumps.

The Meter-Pak system features individually adjustable valves for delivery of from 0.003 to 0.015 cu. in. of oil each time the system is cycled. Delivery is claimed to be ±5% over all ranges of volume and pressure settings, regardless of oil viscosity, type, or temperature. Pressures may range from 100 to 7,000 psi.

Either pneumatic or electric signaling devices indicate positive delivery of lubricant. If no lubricant is delivered, a pneumatic impulse action shuts down the equipment and an audible or visual signal is given. Source: **Stewart-Warner Corp., 1826 Diversey Parkway, Chicago 14, Ill., U.S.A.**

20,000 PSI Controlled by W-K-M Balanced Stem Valves

The cutaway illustration below illustrates how W-K-M Balanced Stem Valve gives positive finger-tip control of high pressures. The balancing stem at the bottom balances out the direct stem thrust inherent in most valves, resulting in the easiest possible operation. No other high pressure valve provides such positive control over seating pressure.


W-K-M Balanced Stem Gate Valve
1-11/16" — 2-9/16"
10,000; 15,000; 20,000 psi W.P.
W-K-M Single Balanced Stem Valve
Dual Balanced Stem Valve
Composite Balanced Stem Valve
Write for Catalog 200
P. O. Box 2117, Houston 1, Texas

W-K-M DIVISION

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ROPER PUMPS

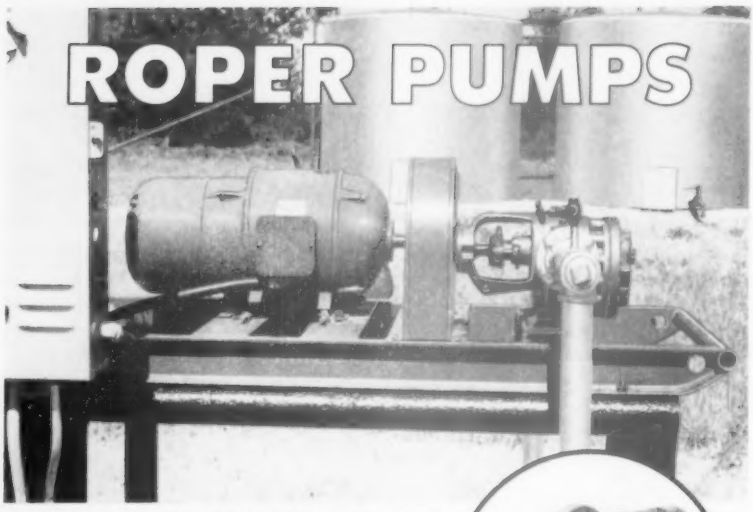


Photo courtesy Harley Sales Co., Tulsa, Wichita, Houston

SERIES H MODEL H-20 SPEC. 5

low cost units designed to meet changing requirements of producers

• **OUTPUT CAPACITIES: 5-75 gpm** • **OPERATING AT PRESSURES TO 1000 PSI**

This Oklahoma oil field unit is packed box Model H-20, mounted on stilts as protection against the lowland area's frequent floods. Normal production of 18 barrels per hour is maintained at 400 psi discharge pressure. Pump is short-belted to 5 hp electric motor and both units are mounted on structural steel skid for easy installation or removal for use elsewhere.

Low initial price and its flexibility to meet changing oil field requirements are two features which make the Series H a popular unit with oil producers. Designed to operate at direct motor speeds, its dependable output at high pressures makes it ideal as pipeline gathering unit or as carrier of crude oil from lease to pipeline system. Replaceable wearplates and reversible center case make the Series H economical to operate, easy to maintain.

Engineered Protection Against Wear

• **THRUST LOADS** are absorbed by drive shaft, separate from drive gear.

• **FRICTION** is reduced, especially in heavy loads, by roller bearings and bronze wearplates, two on each side. Journal and bearings are lubricated and protected against overheating by hydraulic action.

• **PERFECTLY BALANCED** construction and precision manufactured hardened and ground gears maintain high volumetric efficiency of Series H at great pressures.

For information about your specific pump needs contact your nearest Roper dealer

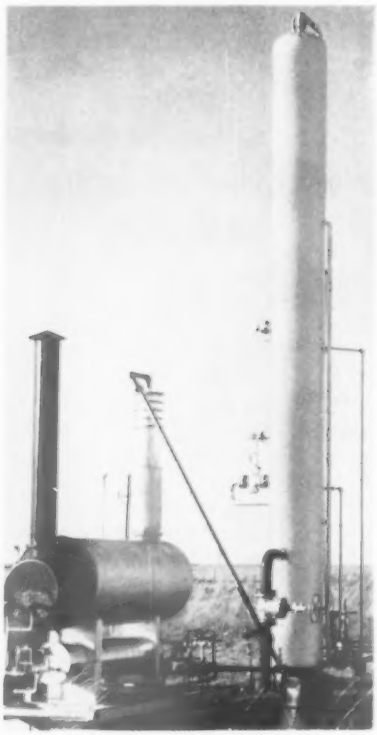
Send for "How to Solve Pumping Problems" booklet

ROPER HYDRAULICS, INC.

Dependable pumps since 1857

COMMERCE, GEORGIA

New Process Solves Gas and Condensate Co-mingling Problems



Maloney-Crawford's new Duo-Dry process eliminates the need for separate lines to carry your gas and condensate from the well to central facilities. It can accomplish this even when line heaters have not been satisfactory. In the Duo-Dry process, a single contactor vessel dehydrates gas, then uses this under-saturated gas to strip solution water from condensate. The gas then is dehydrated in the usual manner. The dehydrated gas and condensate can be recombined in the same pipeline without the danger of downstream freezing. It is a trouble free process using only proven contact methods. No untried desiccants. The savings can be large for isolated wells, especially those in colder climates, and offshore locations. Don't lay an expensive second line without investigating this low-cost alternative. Get the details today.

Maloney-Crawford

P. O. Box 659 Tulsa, Okla.

What's NEW

... in literature

Indirect-fired fin-tube heater

Eight-page Bulletin 400 offers a description of the unit showing how the fin tube maintains low metal-wall temperatures in the heater so that no refractories are required. General specifications and capacities are presented which include ability to obtain temperatures up to 1,200° F., capacities to the 5 M.M. B.t.u. per hour, and pressures up to 300 psi. Source: **Brown Fin-tube Co., 300 Huron St., Elyria, Ohio, U.S.A.**

German group fosters cooperation between chemists and engineers

Another goal lies in the promotion of research and education in the field of chemical engineering and chemical technology, as described in a new 20-page organizational brochure. The publication highlights facilities of the 3,000-membership group while explaining various services. Source: **Deutsche Gesellschaft Fur Chemisches Apparatewesen, Box 7746, Frankfurt (Main) 7, Germany.**

Fluid-end parts for slush pumps

Newly issued Bulletin 523 includes "super dual seal" pistons and G-2 fluid valves and seats with recent refinements in design said to contribute to performance and long life. The eight-page booklet also gives installation and maintenance tips for liners, valves, seats, pistons, and piston rods. Source: **National Supply Div., Armco Steel Corp., Two Gateway Center, Pittsburgh 22, Pa., U.S.A.**

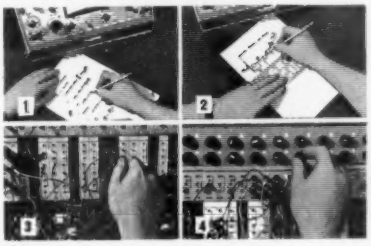
Engine-driven electric-generating plants

The pocket-sized booklet traces the history of electric-plant development from early stages where storage batteries were necessary to today's modern, single-unit, engine-generator power plants. Described in simple, easy-to-understand text are the three general groups of electric plants: alternating current, di-

EXPERIENCE IN DEPTH...COMPUTING, PLOTTING, INSTRUMENTS, SYSTEMS, PROCESS CONTROL

4 STEPS TO FASTER OPTIMUM SOLUTIONS

Wasteful "trial and error" engineering is drastically reduced when you rely on a PACE TR-10 Desk-top Analog Computer.



Follow these simple steps:

1. Represent in equation form the physical system to be studied.
2. Select through a simple computer diagram the components required for the calculation.
3. Interconnect components on the TR-10 panel and set problem parameters with adjustable controls.
4. Run the problem comparing effects of parameter variations. Select optimum solution.

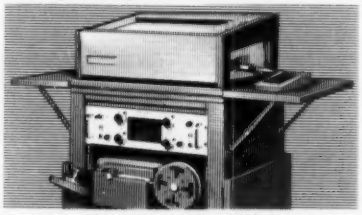
This compact, accurate and reliable engineering tool can be used right on your desk, laboratory bench or even at a field location. Modular interchangeable components are available to perform the following computer functions: summation, integration, multiplication and division, function generation, parameter adjustment and logical comparison. Computer components are accurate to ±0.1%.

Engineering departments utilizing the EAI Model TR-10 Analog Computer can explore new approaches to system design without the penalty of excessive calculation time. Studies of interrelated effects of heat, pressure, flow, vibration or any other variable of system dynamics now become economically achievable.

For complete details write to Department 83.

DIGITAL PLOTTING – WITH ACCURACY AND LOW COST

Dramatic improvement in the accuracy of 11 x 17 inch x-y plots of digital data is now available with EAI Series 3100 DATAPLOTTER. The low cost of this instrument makes available a rapid and economical substitute for laborious hand plotting.



Outstanding features of EAI Series 3100 DATAPLOTTERS include:

- System accuracy up to 0.175% of full scale
- Punched card, tape or keyboard input
- Plotting speeds up to 80 points per minute
- Provisions for "off-board" origin
- Compact, single-cabinet design. Punched card reader external
- Adaptable to any computer system
- Accepts analog and digital inputs

Transistorized control circuitry insures high-speed, accurate, reliable operation. The EAI Series 3100 DATAPLOTTER makes readily available a low-cost tool for fully exploring experimental design problems. It is particularly applicable in data reduction and instrumentation installations. As a management tool, it is valuable for the conversion of computer intelligence to graphic representation of sales, production and cost data.

For specific details on the Series 3100 DATAPLOTTERS or complete data on the full line of EAI DATAPLOTTERS, write to Dept. 84.

EAI

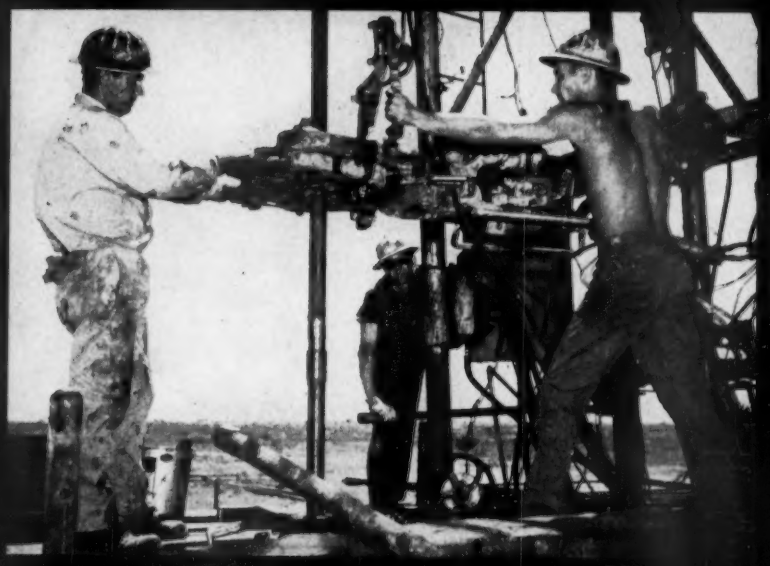
Career Opportunity for Engineers— Graduate or advanced degrees in EE, Physics, Math— call or write Gordon Strout, Director-Personnel

ELECTRONIC ASSOCIATES, INC. • *Long Branch, New Jersey*

J.L

SUPPLY

Production kinks and



costs.....here's real help

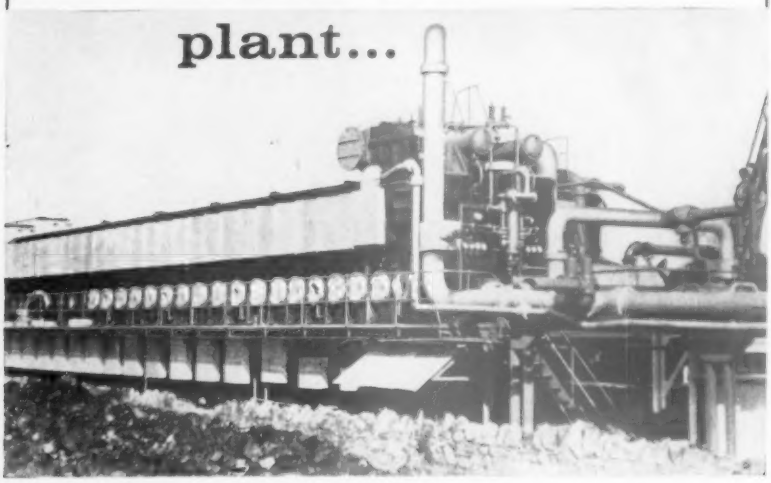
Performance proved production equipment from J&L includes: portable waterflood units; Major MACT units; J&L casing and tubing, including slim hole and macaroni; Cabot pumping units; Axelson rods and Axelson bottom hole pumps.

J&L engineers and production specialists will back your determination to raise efficiency and lower end-costs.

If it's sold by J&L, it's the best available. You can depend on J&L equipment, experience, and service. Call your J&L Supply man or write us in detail—1425 Sheridan Road, Tulsa.

Jones & Laughlin Supply Division—Tulsa

the world's most efficient seawater distillation plant...



...so economical to operate it pays out even where rainfall is plentiful

The 600,000 gallon per day Weirwater Plant on the Island of Guernsey in the English Channel provides "rain insurance" to a thriving agricultural industry. Significant is the fact that this is the first seawater distillation plant in an area of more than adequate rainfall and yet a Weirwater Plant proved to be the most economical solution. High local fuel cost dictated a maximum economy design and Guernsey's Plant produces more than 22 gallons of Weirwater for every pound of fuel, making it the world's most efficient seawater distillation plant.

Weir Chicago Bridge INC

50 Broad Street, New York, N.Y.

Combining the experience of
G. & J. Weir Limited of Scotland and the Chicago Bridge & Iron Company, U.S.A.

weirwater

WC-611

DISTILLED FROM THE SEA

rect current, and battery charging. The literature reviews the three prime-mover types which furnish mechanical power for driving the generator, namely gasoline, diesel, and gas engine. Booklet F-167 outlines cost of operation and installation of each type, and includes differences of engine cooling and starting methods. Source. **Onan Div., Studebaker-Packard Corp., 3628 University Ave., S.E., Minneapolis 14, Minn.**

Used-drill-pipe inspection system

A new eight-page bulletin details the Tru-Tech-Tron pipe-inspection system, said to eliminate the problem of noise interfering with the accuracy of defect recordings. The publication features the instrument's operation principles, accuracy, and special features. Source: **Universal Inspection & Service Co., Box 66669, Houston 6, Tex., U.S.A.**

Gasoline exhaust-fume

...exposure for the lift-truck driver, is the subject of newly issued Report 107 now available. The findings, contained in the Report, show that the driver of the test vehicle was exposed to concentrations of carbon monoxide and hydrocarbons despite well-ventilated conditions. They show that under all conditions the driver of the lift truck is breathing in quantities of noxious carbon monoxide and cancer-suspect hydrocarbons. Infrared spectrophotometric equipment was used to test the atmosphere. Samples were taken from the driver breathing level. Source: **Oxy-Catalyst, Inc., Berwyn, Pa., U.S.A.**

Globe, angle valves

...of ductile-iron construction, are presented in six-page Catalog PA. The valves are shown in ½ through 3-in. NPT and 1½ through 3-in. ASA 300-lb. flanged connections. A cutaway sectional view outlines design advantages. The catalog gives complete details on pressure-temperature ratings, materials, dimensions, and flow characteristics. The back cover presents a list of 171 different fluids with which these valves may be used. Source: **RegO Div., Bastian-Blessing Co., 4201 W. Peterson Ave., Chicago 46, Ill., U.S.A.**

▶▶▶ Equipment Men Notes

Kenton Chickering is director

Kenton Chickering

. . . of marketing services for Oil Well Supply Division of U. S. Steel Corp., announces W. A. Weir, vice president of sales. Chickering will locate at division headquarters in Dallas and will be responsible for various sales-supporting staff activities including advertising, market development, and commercial research.

Chickering joined Oil Well Supply in 1928 at Imperial Works, Oil City, Pa. In 1933 he was transferred to Dallas where he was placed in charge of advertising. In 1944 he was appointed manager of commercial research, and in 1952 was named staff manager of the general sales department.

Consulting offices are opened

. . . at 4801 Richmond Ave., in Houston by Hubert Guyod and John A. Pranglin for domestic and foreign well-log analysis.

Guyod is well-logging consultant with Electro-Tech Labs Division, Mandrel Industries, and will remain with the firm in that capacity. Prior to this association he was with Schlumberger, Halliburton, was an independent well-logging consultant, and was president of Well Instrument Development Co., until the acquisition by Mandrel Industries.

Pranglin has, for the past year, been engaged in research on interpretation of the nuclear magnetism log for Byron Jackson Division, Borg-Warner Corp. Prior to this he was associated with Guyod in a study of well-log analysis.

New Houston offices opened

. . . at 620 Texas Ave., by American Photo Copy & Log Service. The quarters, which contain 50% more working space, were needed for the firm's electric log library in addition to housing of new reproduction equipment. At the same time, owner Charlie Blankenship had installed a complete new printing department.

Thomas Sutton becomes prexy

T. C. Sutton

. . . of OPW Division of Dover Corp., announces Fred D. Durham, Dover president. The OPW Division is located in Cincinnati. Sutton has been with the division the past 10 years, starting as an administrative assistant to the vice president of sales. He was elected vice president in 1955 at which time he headed manufacturing. In 1957 he was placed in charge of sales.

REGIONAL MANAGERS of Bethlehem Steel Co.'s Supply Division held their quarterly management meeting recently at the Tulsa headquarters. J. V. Spalding, general manager of sales, conducted the sessions which were opened with remarks by C. R. Zimmerman, division vice president. Shown are, front row, from left: J. V. Spalding, C. R. Zimmerman, and C. C. Crider; second row: H. A. Wilson, E. R. Phillips, H. R. Powers, M. R. Griffith, F. C. Underwood, and Lee Fagg; top row: H. L. Hawkinson, Jr., T. C. Graham, H. V. Harder, C. R. McNair, L. C. Graves, and Arthur Weber, Jr.

Robert Lewis elected president

R. E. Lewis

. . . and chief executive officer and a director of Perkin-Elmer Corp., announces Richard S. Perkin, board chairman of the Norwalk, Conn. scientific-instrument manufacturer. Lewis resigned as president of Sylvania Electric Products, Inc., to accept the new position.

Lewis has served as treasurer and a director of American Steel & Wire Co., president of Cleveland Wire Spring Co., and controller and assistant to the president of Batten, Barton, Durstine & Osborn, advertising agency.

Chicago Bridge & Iron elects

. . . George E. Borst and Edward S. Fraser as directors of the steel-plate fabricating and construction firm. Borst, a company vice president, is manager of CB&I's eastern sales region. Fraser is vice president of manufacturing.

Retiring from Bethlehem Supply

. . . following 39 years service is C. C. Crider, general manager of regions. Crider assisted in the formation of Taubman Supply Co. in 1922. When Taubman sold out to Bethlehem Steel in 1937, he remained with that organization as division manager at Houston. Crider later moved to Tulsa where he became general manager of stores in 1957 and general manager of regions 2 years ago.

Byron Jackson Pumps sets up

. . . a new Midland, Tex. district office and promotes Paul Frisbie to manager of the Plainview, Tex. district office. The report comes from Norman D. Jesse, vice president and general sales manager of the Borg-Warner subsidiary.

Frisbie replaces B. D. Turner who recently transferred to Los An-

geles as product sales manager for BJ standard pump products. Both the Midland and Plainview district offices are now a part of the Mid-Continent region, under the supervision of Robert H. Hicks.

Grove Valve & Regluator to build

. . . a new manufacturing plant near Mexico City to be operated by Grove de Mexico, S.A., a subsidiary of the Oakland, Calif. company. When the plant is finished later this year it will have the capacity to manufacture pipeline gate valves in diameters up to 36 in. Grove valves are now being manufactured in France, Italy, and England.

Johnston Testers, Inc. names 6

. . . to staff a Texas sales and service network for the company's Sonic Pump, according to E. W. Stokey, Sonic Pump sales manager. Sales and service engineers and their locations are: Tom Cunningham, Abilene; Bob Lee, Corpus Christi; Freed Little, Houston; Ralph Krottinger, Odessa; Bill Pyle, Pampa; and Horace Darnell, Wichita Falls.

Bucyrus-Erie names R. L. Smith

. . . as manager of sales promotion. He had been a sales representative attached to the firm's Chicago regional office for 6 years. During that period he represented the company in Detroit and other mid-western areas. From 1949 to 1955 Smith was employed as a sales representative by Minnesota Mining &

TEN YEARS' EXPERIENCE . . .

. . . in custom design, engineering and fabrication of heat transfer equipment for gas treating, processing, and allied industries.

Let our staff of specialized, experienced gas treating and processing engineers consult with you at no obligation on your specific heat transfer problems.

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P. O. Box 3266
TE 3-1879
Beaumont, Texas

REX BIRCKET
424 So. Cheyenne
LU 4-6651
Tulsa, Okla.

TEST WELL designed specifically for fishing tools is located at the Houston plant of Bowen Itco, Inc. The 300-ft. cased hole, fully cemented to the surface, is equipped with a special latching device anchored at the bottom of the well to engage the tool being tested. The latching device stimulates the load of pipe and tension exerted on the tool. It also checks jarring action and stress to which tools are normally subjected in the hole.

Mfg. Co. in the Kansas City and St. Louis areas.

Axelson-Garrett establishes

Ross Brewer

. . . a new district office for Garrett Sales & Service in Odessa to serve the West Texas area. Ross Brewer, newly promoted to district manager, most recently was sales engineer in Houston. Prior to that he held the same title in Odessa. At the same time, Lowell Stell was named district manager for Garrett's Hobbs office, serving eastern New Mexico and neighboring West Texas.

Douglas Mueller named director

Douglas Mueller

. . . of public relations and advertising for Borg-Warner Corp., succeeding the late Donn Sutton. Mueller will work at Borg-Warner's Chicago headquarters. For the past 10 years Mueller has been assistant to the president of Seiberling Rubber Co., Akron, Ohio, and in November 1960 was named director of merchandising and public relations for the firm.

Schlumberger shifts personnel

. . . in Louisiana. W. H. Throop, location manager at Monroe, has been transferred to Houma as motor-vessel location manager, while T. W. Cobb has moved to Houma to head the location's truck-services operations. Cobb previously served as location manager at Venice.

C. R. Perry, senior sales engineer in the South Louisiana division, has moved to Venice to serve as manager of that location. F. A. Eastman, former location manager in Houma, shifts to Monroe to take on the duties of location manager.

J. S. Fischer, field engineer—special services at Gretna, has been reassigned to the South Louisiana division office at New Orleans as sales engineer. A. O. Phares, former manager of the Houma motor-vessel location, has been shifted to North Dakota to serve as Williston location manager.

Charles L. Foss to assist prexy

. . . of Security Engineering, Dallas manufacturer of rock bits and oil tools. Foss goes to Security from a similar post with Dresser Mfg. in Bradford, Pa. Both companies are divisions of Dresser Industries, Inc. Joining Dresser in 1952, Foss became a staff analyst, manager of the profit-planning division in 1954, and assistant to the president in 1959.

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avoids use of mud
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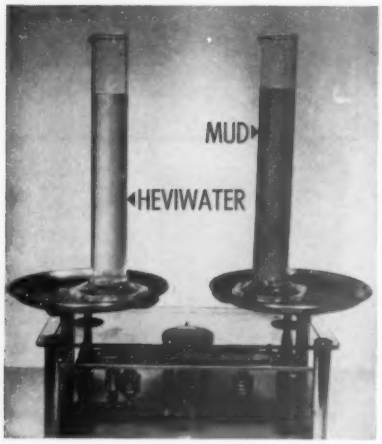

Heviwater* completion fluid is a solution of fresh water, calcium chloride, suitable corrosion inhibitors, and zinc chloride if fluid weights above 11.8 pounds per gallon are desired.

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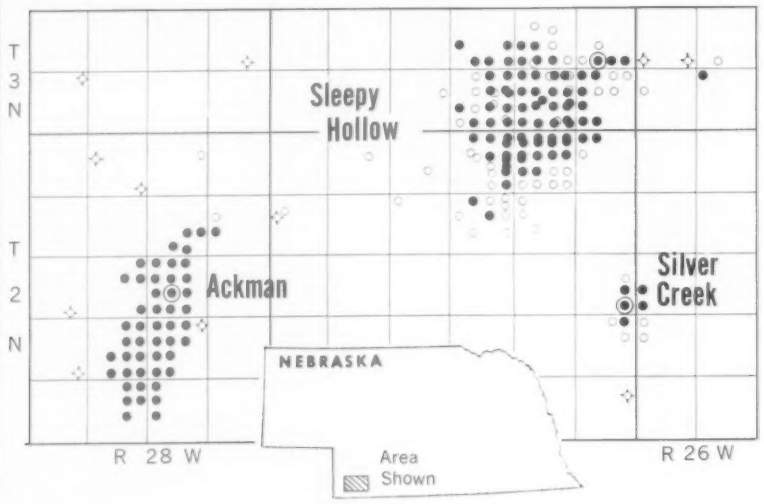

DATA ON
ACTIVE FIELDS

Sleepy Hollow area, Red Willow County, Nebraska

1. Approved field names: Sleepy Hollow, Ackman, and Silver Creek. Location: Red Willow County, Southwest Nebraska, on the Cambridge arch geological province.

2. Discovery wells: Ackman-Frontier Refining Co. 1 Reiners, NW NE SW 14-2n-28w, IPP 122 BOPD of 28° oil with 6% water. Perforated intervals 3,273-3,310 ft. with 12 ft. of pay in the Lansing-Kansas City. Completed November 11, 1959. Sleepy Hollow-Murfin Drilling Co. 1 Barth, C SE SW 25-3n-27w, IPP 144 BOPD in the Cambrian-Reagan from perforations at 3,418-22 ft. Well was completed July 5, 1960. Silver Creek-Burch Drilling Co. 1 Nokes, C SE SE 13-2n-27w, with IPP of 47 BOPD from Lansing-Kansas City perforations at 3,288 ft., completed July 14, 1960.

3. Trend of development: Each field has usually been extended in a north-south direction. After the uncovering of the deeper Cambrian-Reagan pay at Sleepy Hollow, most Cambrian wells were twinned with a Lansing-Kansas City well. Dual completions are a common option of twins.

4. Number of producing wells: Ackman 50; Sleepy Hollow 140 (incl. twins); and Silver Creek 4.

5. Spacing pattern: 40 acres.

6. Proved acreage: Ackman 2,680; Sleepy Hollow 5,200; Silver Creek 240. These figures are minimum estimated, but more is possible.

7. Principal operators in area: Pubco Petroleum, Midwest Oil, Ohio Oil Co., Frontier Refining, Franco-Central Oil, Skelly Oil Co., Murfin Drilling, Burch Drilling, Gulf Oil, and M. W. Volentine.

8. Present allowable: None.

Drilling Operations

9. Number of active drilling rigs: Ackman 1; Sleepy Hollow 12; Silver Creek 3.

10. Casing Program: 8⅝-in. surface casing set at 300 ft. with 225 sacks cement. 4½, 5½, or 7-in. oil string set at 3,400 to 3,500 ft. with 150 sacks of cement.

11. Average drilling time: 5-7 days.

12. Types of drilling fluid: Chemical-gel-oil mud. Cost $500-$1,000.

13. Completion method: Perforate casing usually with four shots per foot (2 per foot on upper pay).

14. Types, sizes, and total number of bits: Five-six rock bits, 7⅞-in. below surface pipe.

15. Special drilling problems: Some lost circulation in Dakota at 1,800 ft.

Geology

16. Producing formations: Pennsylvanian Lansing-Kansas City at

depths of 3,275-3,370 ft. Cambrian-Reagan at depths of 3,400-3,550 ft. At Ackman, Topeka produces.

17. Reservoir characteristics: Type drive not determined—acts like oil-expansion-solution gas. Gas-oil ratio, nil. Oil-water contacts, varies −743, −968, −977, −990. Gas-water contacts, none.

18. Geological markers: In Sleepy Hollow the discovery well, Murfin Drilling Co. 1 Barth, Lansing, 3,116 ft., base Kansas City, 3,368 ft., "Reagan,"* 3,418 ft. Precambrian, 3,453 ft. Some firms call this basal Pennsylvanian or Demoinesian-Cherokee.

19. Type trap: Lansing-stratigraphic trap with structural implications. Reagan-structural nose with stratigraphic sand conditions.

20. Core data: (Lansing-Kansas City) Porosity 14.1%. Permeability 27.6 md. Residual-oil saturation 19.6%. Total water saturation 56.3%. These figures given were for core analyses (seven-well average) at Sleepy Hollow.

For Cambrian-Reagan, the following are: Porosity, 21.9%. Permeability, 2,800 md. avg. (up to 17,790 md.). Residual oil saturation, 32.1%. Total water saturation, 41.9%. Connate water, 15-20% (average of 10-well core analyses).

21. Estimated recovery: 100 (Lansing) bbl. per acre-ft. Barrel per well average is: 50,000 Lansing; 200,000-250,000 in Reagan.

22. Pressures: IBHP: Reagan, 850-900 psi.; Lansing, 1,211 psi.; and shut-in, 850-880 psi.

23. Tests and logging procedures: Drill-stem tests and cores are run in pays. Holes are logged with Es-Induction logs from surface pipe to TD. Gamma-ray, caliper, sonic, microlaterologs are run from 200 ft. above Topeka to TD.

24. Pipeline outlets: Oil is trucked by Pitkin and Rock Island Refining. Rock Island Refining Co. is the crude purchaser.

25. Exploration methods before discoveries: Seismic, surface, subsurface, core drill, and random drilling.

26. Average costs: Dry hole, $14,000. Pumping well, $40,000-$42,000. Average total depth, 3,500 ft. Footage rate, $2.50. Day rate with pipe, $700; without pipe $650.

27. Crude analysis: Gravity, °API 30-31.4; Sulfur, % 0.4.

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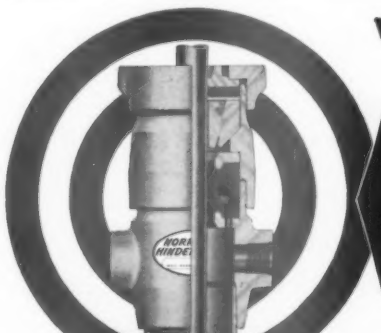

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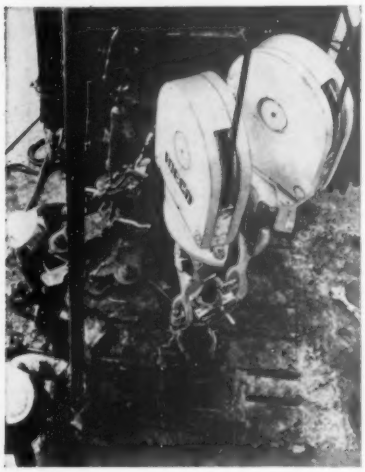
Ideco Dual-Speed System . . .

Saves 30% to 50% Trip Time!

Running or pulling four 30′ stands of tubing a minute has proved to be average time for a rig equipped with the Ideco Dual-Speed System. Field reports from Texas and California indicate that the system will reduce by 30 to 50 percent the time normally required to round trip a string of tubing.



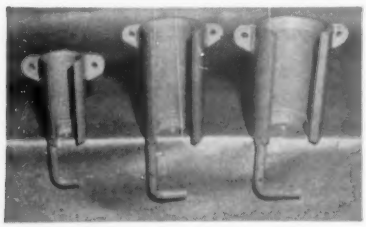
DUAL-SPEED BLOCK is hoisting another stand as freed stand is being racked.

Major Advantages

The Dual-Speed System has proved to be faster, safer and more economical than the conventional method. Crews working with the system say they work faster, but the work is much easier. After one round trip, average crews are proficient in operating the Dual-Speed System and they are enthusiastic about the ease of operation.

Basic Equipment

The Ideco Dual-Speed System utilizes a divided-type traveling block with an "Open-Swivel" link adapter, automatic elevators, and a transfer elevator.



TRANSFER ELEVATORS are available for various sizes of tubing and pipe.

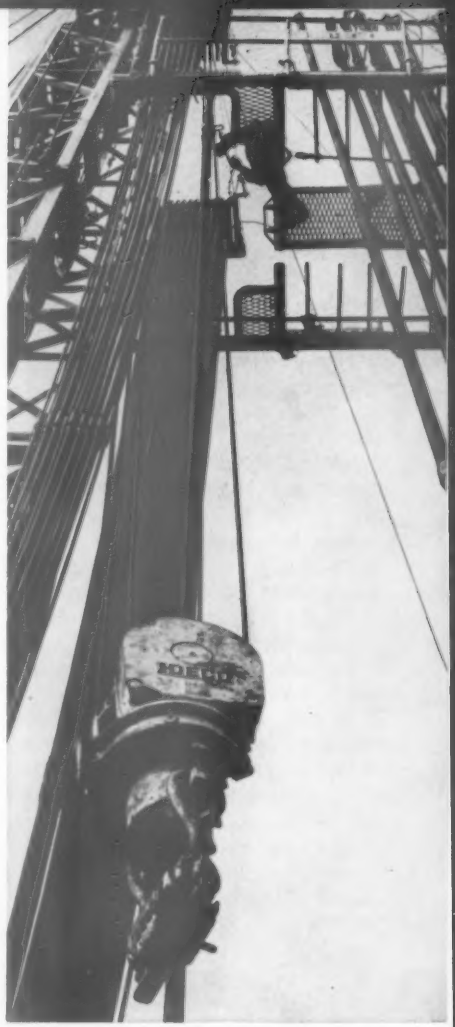
Trip time is greatly reduced because the traveling block and elevators move up and down in almost continuous motion. This eliminates the time required with a conventional system when making or breaking a connection. The transfer elevator supports the pipe when "setting-back or stabbing" a joint.

The Dual-Speed System is available with either two or three-sheave blocks equipped with Ideco Fabriform sheaves mounted on Timken tapered roller bearings. The "Open-Swivel" adapter has an 8½″ front opening and a 12″ diameter center bore that allows sufficient space for running tubing, gas-lift valves, tools and other equipment. The swivel adapter can be rotated 360 degrees and can be locked in seven positions.

AUTOMATIC ELEVATORS remain around tubing at all times during trip.

Principles of Operation

In coming out of the hole, a stand is hoisted, the slips are set, and the traveling block started down while the crew is breaking out the joint. The automatic elevators remain around the tubing at all times. As the traveling block is falling, the derrick man slips the transfer elevator around the stand. As soon as the elevator passes the broken out joint, the tong man actuates the hydraulically-operated transfer elevator. This lifts the freed stand out of the collar and allows it to be set back in the racking platform while another stand is being hoisted by the Dual-Speed Block. The procedure is reversed when going in the hole.



COMING OUT OF THE HOLE . . . traveling block is on the way down as the 60′ stand is being broken out on this "doubles" mast. Derrick man is attaching transfer elevator.

Idle block time is reduced almost to zero, for the pipe is not supported by the traveling block while a connection is being made or broken.

Ask the Ideco representative in your area to show you the DUAL-SPEED SYSTEM motion picture field report.

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ONE DOWN AND ONE TO GO—that's the score in Alabama's two-well wildcat probe of the pre-Cretaceous section. H. L. Hunt recently abandoned the 1 Tyler-Odom at 18,716 ft. (electrical log shows 18,741 ft.) in Washington County. To the southeast, in Citronelle field, Jett Drilling Co. is still active at the 1 Citronelle unit B-31-7, with drill pipe stuck at 17,255 ft.

Alabama's deep future hinges on Citronelle test

BY FRANK J. GARDNER

THEY'RE DIGGING DEEP in Dixie—and so far, it's a dry dig. Alabama's much-publicized duet of ultradeep tests has scored one failure, and one still trying.

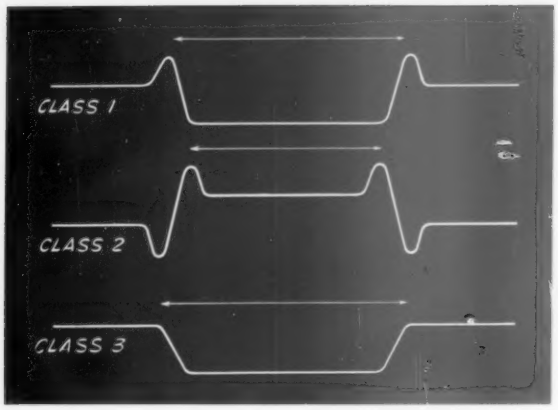
The deeper of the two, and depth-record breaker for the state, was abandoned March 26 at 18,741 ft. after penetrating Smackover-Jurassic and bottoming out in salt. This was H. L. Hunt 1 Tyler-Odom on the 20,000-acre Vinegar Bend prospect in Section 13-3n-4w in Washington County. Details on the dry wildcat have not been released, but it was rumored to have had noncommercial gas in the Smackover section. This deep hole, originally projected to 19,000 ft., was contracted to Penrod Drilling Co. and was 5 months in the drilling.

High hopes deflate . . . The Vinegar Bend wildcat was of special interest to southeastern operators. The drill site was staked on the basis of seismic surveys and a deep five-well strat-test program. The acreage block was assembled by Seneca Development Co. and Everett Eaves, the same team that discovered big Citronelle field to the southeast; it was almost fully unitized (75%) and spacing rules were set before the drilling began. Surveys showed a northwest-southeast gravity anomaly, and the initial test was spudded with high hopes. Hunt earned one-half interest in the acreage by drilling the 1 Tyler-Odom, and it is reported that another wildcat will be drilled on the prospect, but this depends on the outcome of the deep test in Citronelle field, our second item of interest on the map.

In the south-central part of Citronelle, Jett Drilling Co. is fishing at 17,255 ft., where the drill pipe was stuck. This deep field wildcat, the 1 Citronelle unit B-31-7, lies in Section 21-2n-2w, Mobile County. It's a 20,000-ft. project, and if carried to that depth will give Alabama its second depth record for the year. Its objective is to test thoroughly the pre-Cretaceous possibilities of the field. Regular pay horizons of lower Glen Rose age were cased off at 11,513 ft. with 9⅝-in. casing.

One interesting bit of geology has already come from this deep hole. In Cotton Valley-Jurassic section, at about 16,000 ft., the drill found soft, unsorted sand, and drilling was limited to 20 ft. per hour in order to keep the hole in shape. No shows of oil were found in this unusual section.

But effort goes on . . . These two explorers are symbolic of the great interest and confidence that Dixie operators have in the deep possibilities of the three southeasternmost states. Not one field has been found at **any** depth since Citronelle in 1955. But wildcats continue to dot the landscape in Alabama, Florida, and Georgia. And the offshore Florida area consistently draws new exploration. Such effort surely must meet a payoff eventually, if the odds of oil history mean anything and we're sure they do.



RADIOACTIVITY ANOMALIES are divided into three general classes. Class 1 is often associated with reservoirs having major faults as their limits. If the faulting only serves as one limit, the other end of the anomaly will have a different shape than shown. Class 2 is often observed over subterranean reef production or over a very radical facies change. Class 3 is the type profile usually found over production associated with stratigraphic traps. The arrows define the portions of the record indicating the greatest probability of successful production. Fig. 1.

Radioactivity surveying as an exploration tool isn't new. What is new is the modern approach to it, the recognition of its capabilities and its shortcomings, the attempt to learn the basic mechanism. This new approach is winning the method an accepted role in the hunt for oil.

BY WILLIAM D. CREWS, President
Exploration Unlimited, Inc.
Tulsa

SINCE THE EARLY 1930's it has been known that a relationship exists between surface-radioactivity variations and the accumulation of hydrocarbons at depth. This phenomenon is the result of complex natural mechanisms and until after World War II little but empirical information was known.

During the 1940's interest in radioactivity surveying as an oil-exploration tool grew, and literature on the subject began to appear. At this point the method began a two-pronged growth: one, scientific investigation, and the other, strictly promotional. The promotional approach received the publicity and because of the unscrupulous proponents, notoriety. Fortunately, most of these irresponsible operators have fallen by the wayside leaving the expanding future of radioactivity surveying in the hands of legitimate explorationists.

During this time, investigations were being carried out to determine: (1) The proper instrumentation required to make reliable radioactivity surveys; (2) the proper field techniques to obtain the most useful data; (3) the most effective means of processing data for consistency in interpretation; and (4) plausible theories explaining the existence of these anomalies and their association with oil at depth.

Presented at the Annual International Meeting of SEG at Galveston, Tex., November 1960.

The United States, Canada, and Russia are the leaders in this field. American and Canadian literature has many articles explaining possible field techniques, as well as many references to possible theories explaining the mechanisms responsible for these significant anomalies. Russian literature has only references to the widespread use of the technique as an adjunct to their geochemical approach to petroleum exploration.

Why do radioactivity anomalies exist? There are many theories attempting to explain the origin of surface-radioactivity anomalies which coincide with the accumulation of hydrocarbons at depth. Most of these require that hydrocarbons, water, and radioactive particles be physically transported from depth to surface and there be deposited where their radioactivity may be measured. Most of these theories have limited acceptability.

To be true they call for circumstances which are usually not present; for instance, (1) It would be necessary that this migration of material be perfectly vertical from its origin to the surface; (2) the resulting deposition of these particles at the surface would render the radioactivity anomaly itself completely susceptible to the elemental forces of nature, hence, the measure of the radioactive variations would reflect only the patterns of surface drainage; (3) the radiation pattern would certainly change from season to season and year to year; and, (4) the nature of the top soil would have a great effect upon the existing radioactivity because of the differences in the soil's ability to absorb and hold the deposited particles.

A rather novel hypothesis which appears to more nearly agree with both laboratory and field investigations has been proposed. (OGJ Aug. 3, 1959, p. 130.) This requires a series of radioactivity inducements and subsequent reemissions originating at depth and eventually reaching the surface. This phenomenon is known as "photodisintegration."

Requirements for this hypothesis include (1) The ordered distribution in the earth's crust of radioactive

INSTRUMENTS are mounted in this four-wheel drive GMC panel truck equipped with all-weather tires, structural reinforcement, brush protectors, and front end winch. Fig. 2.

particles and heavy mineral components as influenced by the same factors that control the existence of reservoirs and the accumulation of oil; (2) the petroleum accumulation must act as an energy-transfer medium (an energy absorber) for the gamma radiations which encounter it. Work by the Bureau of Mines Petroleum Experimental Station at Bartlesville, Okla. has shown this condition to exist.

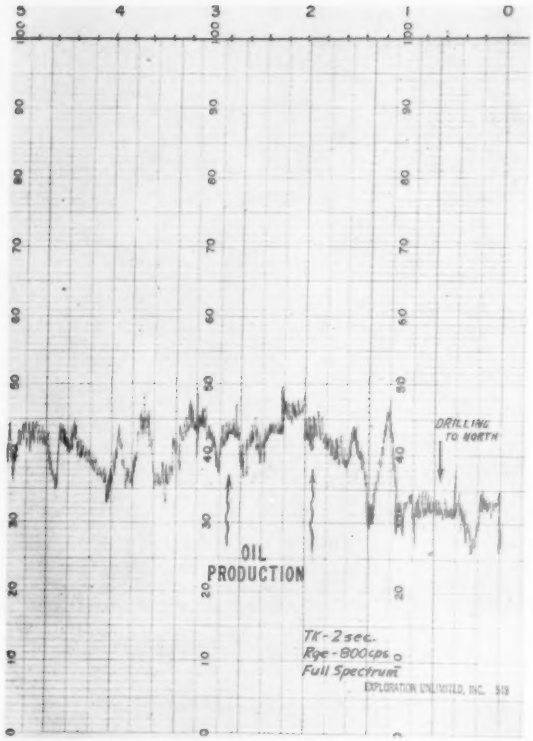
It is not proposed that this single factor is the only one contributing to radioactivity anomalies at the surface—only that, as related to the detection of oil accumulation at depth, this is the major controlling mechanism for the existence of the significant surface-radiation anomalies. Certainly, there are many other mechanisms contributing to natural surface radioactivity but these are mostly eliminated by suitable corrections during data processing.

TRUCK INTERIOR shows instrument arrangement. The basic unit is a Mount Sopris field-adapted gamma-ray spectrometer. The center cylinder is the radiation detector head and in lower right foreground is an 1,800-lb. lead shield which will accommodate the pick-up head. A Brown recorder is at left and it can be controlled by either the speedometer or an electric-motor drive. The cabinet at the rear contains a 2,000-watt Onan generator and controls. Fig. 3.

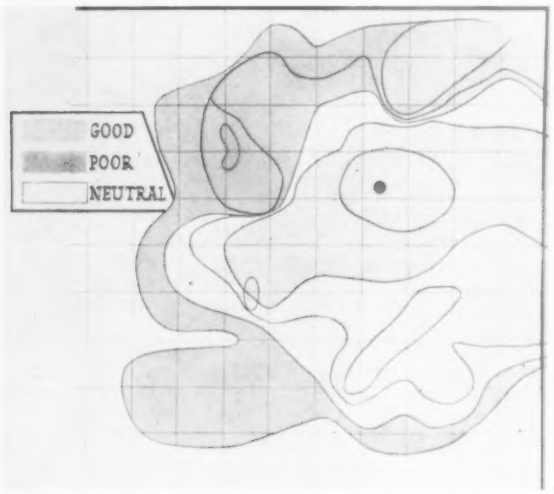
How to measure radioactivity. Reliable measurement of **any** radioactive intensity is possible only through the application of statistical counting. This becomes more important as the radioactive intensity decreases. In the technique of radiation surveying, small changes in an already very low radioactivity intensity are being measured. Thus, for reliability, the requirement is for radioactivity - detection equipment which is extremely sensitive, exceptionally stable and capable of a high degree of resolution.

Our experience has been that a field-ruggedized, analytical-quality, gamma-ray spectrometer offers the best available surveying instrumentation. Certainly for the measurement of low-intensity gamma radiation, a high-quality scintillation system is the minimum requirement. In our effort to continually improve the quality of radiation surveys, we are presently consulting with several major geophysical equipment manufacturers in an effort to develop simplified precision detection equipment.

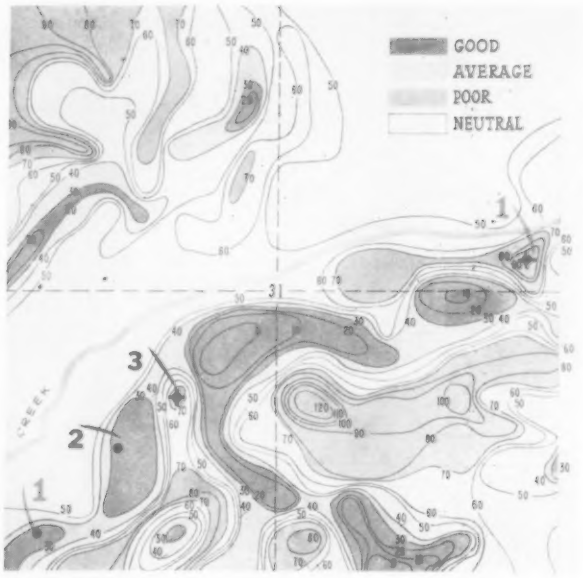
To accompany the choice in radioactivity-detection equipment there must be a separate, dependable, stable power supply. A gasoline-powered generator with auto-



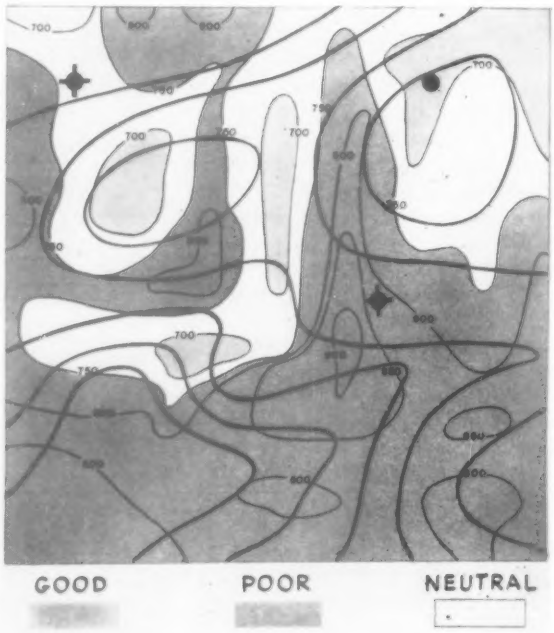
RECORDING of continuous traverse across a known reef-producing field in Southwest Kansas. Note how this pattern coincides with the Class 2 (Fig. 1) anomaly. Fig. 4.



HERE'S AN EXAMPLE of making the best out of a difficult situation and resulting in success. Circumstances forced the radioactivity survey to be done on foot with a battery-powered portable scintillator. Although the resulting data lacked the desired statistical resolution due to instrumentation limitations, an 1,850-ft. well was drilled and produced 25 bbl./d. Fig. 6.



AN ISORADIC map of Cowley County in South Central Kansas was run using a stationary point technique. A modified 330-ft. grid pattern was employed due to rugged surface terrain with a creek with high limestone cliffs on the south bank. At the time of the survey, only the dry hole (1) to the northeast and the well (1) to the southwest were present. Fig. 5.



COMPOSITE MAP of radioactivity and high-resolution seismic data is shown covering a portion of Tulsa County, Oklahoma. The dark contour lines are seismic control on the Dutcher zone. The dry holes preceded both surveys. After the surveys, and as a result of them, the well was drilled and it encountered three pay zones. Fig. 7.

matic frequency controls feeding into an electronic voltage controller will provide an effective power source. This equipment must then be properly mounted in a vehicle capable of negotiating virtually any terrain and which may also be conveniently roaded. Jeeps, four-wheel-drive GMC's and Dodge Power Wagons have all proved useful.

All electronic equipment must be completely shock-mounted with considerable attention given to the load dispersion and vehicle balance. In the interest of simplicity and time economy, the vehicle should be equipped with a rugged, accurate odometer and a precision compass.

This permits rapid and reliable field navigation and station location.

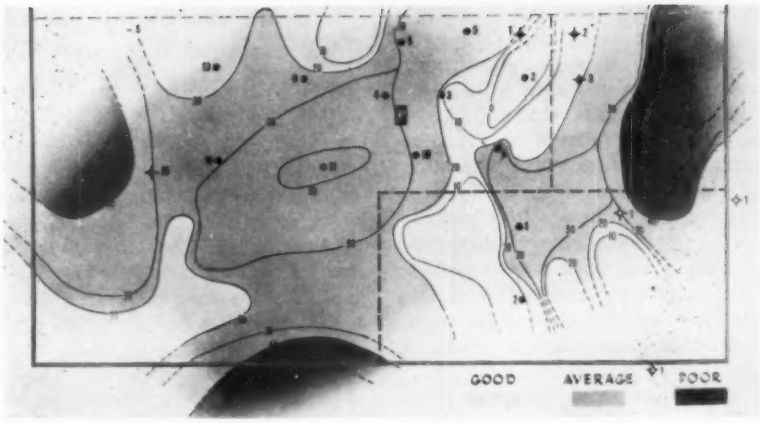
Equipment used. A field unit which has proved extremely satisfactory is shown in Fig. 2. An interior portion of the instrument truck is seen in Fig. 3.

Surveying. There are two general field-surveying techniques; one, continuous traversing; the other, stationary recordings on predetermined grid patterns. The continuous-traversing technique lends itself well to reconnaissance surveys and preliminary prospect evaluation. By increasing the density of the traverse lines, this technique may be used to good advantage for semidetail work on large prospects. As with most geophysical tools, interpolation and extrapolation in areas of insufficient data control are very risky.

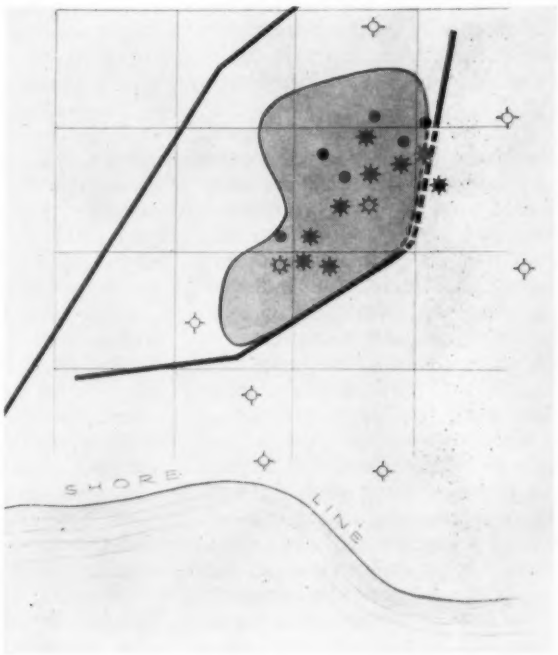
For more detailed surveying, a combined technique of both continuous traversing and stationary point readings is recommended. Specific recommendations depend upon the location of the prospect, the nature of the terrain, probable nature of expected reservoirs and the type of information desired. The cost of these surveys ranges from approximately 5 cents per acre for reconnaissance evaluations to $1-$3 per acre for more detailed surveys.

At this point, it is well to emphasize: it is not recommended that radioactivity surveying be used "instead of" or, that it is "better than" any other accepted exploration tool. Nor is radiometric surveying considered an exploration "cure-all." The contention is that with proper planning, radioactivity surveying can be a beneficial addition to any integrated exploration program.

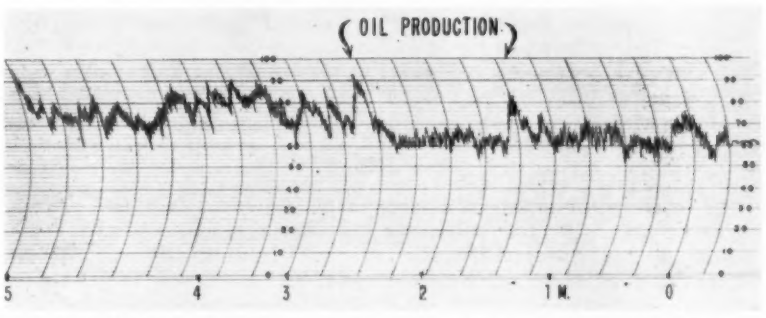
Preliminary radioactivity reconnaissance work can help define the areas worthy of further evaluation by either detailed radiation surveys or other more-expensive exploration tools. Conversely, a radiation reconnaissance can aid in the early elimination of less-desirable prospects. Thus, money is saved by restricting the more expensive and more time-consuming geophysical methods to the higher quality prospects. In the latter stages of prospect evaluations, a detailed radioactivity survey can be used to good advantage by correlation with other studies. For example; if the pres-



A MAP was made to define the ultimate limits of production for a waterflood project in North Texas. Six new wells were drilled after the survey and all encountered between 10 and 15 ft. of pay. The results of the survey indicate that this method is applicable to development programs in addition to use as an exploration tool. Fig. 8.



IN THIS Kleberg County, Texas field, production existed in the Frio sand (light-colored wells). Further development was done (dark wells) after continuous traverse survey was evaluated. Production is from 9,000 ft. A 1-mile grid pattern was used. Fig. 9.



TYPICAL RECORDING is across the Frio sand production on the north end of the field of Figure 9. Pattern is indicative of a Class 1 anomaly and 0 to 5 miles is a west to east traverse. The very high intensity pattern on the anomaly's east side (between 2 and 3 miles) is indicative of major faulting. Fig. 10.

ence of a structure has been confirmed, the radioactivity survey will define that portion of the structure which is most probably productive.

The location of the radioactive anomaly with relation to the subsurface structure can help determine which formation is most probably oil bearing. In areas where the expected reservoirs are stratigraphic in nature, radiation surveys are most useful for correlation with lithofacies studies, isopachous maps, and trending evaluations.

Interpretation of data. The interpretation of field data is, of course, of primary importance.

It is our goal to increase the analytical nature of this interpretation. However, with present knowledge, the process is still empirical in nature and requires much experience. For illustrative purposes significant radioactivity anomalies may be divided into three classes, as shown in Fig. 1.

The anomalies shown may be considered as schematic shapes of continuous radiation readings as recorded on a strip chart. In actual surveying it is very seldom that such clear-cut patterns will be encountered. The actual field recordings may vary from these schematics in magnitude, slope (rate of radiation change), and may even combine characteristics of more than one "class" of anomaly.

The foregoing description is given only as a generalization. This must not be construed to mean that radiation anomalies are always indicative of subsurface geological conditions. The anomalies are associated with the hydrocarbon accumulations and reflect geological conditions only as these conditions affect the existence of the oil in place.

Examples of Surveys

The recording shown in Fig. 4 is the result of a continuous traverse across a known productive oil field in Meade County in southwestern Kansas. Production is from a reef deposit at approximately 5,000 ft. It can be noted that the radioactivity variations define not only the area of oil accumulation but also the probable limits of the reef itself.

In Fig. 5 Well 1 was producing from a Pennsylvanian sand as were other wells to the southwest. Good

"Without exception, the combined consideration of sand thickness and oil saturation as determined by Micrologs agreed exactly with the prediction from the radioactivity surveys."

areas indicate the most-probable production; the average indicate the probability of slightly poorer production and the poor areas indicate the least-probable production. The unshaded areas are considered "neutrals"; i.e., little probability of production.

The information from this survey was not available to the operators at the time the further development of this property was carried out. The agreement of the results of the survey with the further drilling is quite remarkable. Well 2 in the SW/4 is a producing oil well quite similar to Well 1. Well 3 in the SW/4 was not only a dry hole but found the target-sand section completely shaled out.

The map in Fig. 7 is a composite of a radiation survey and a high-resolution seismic survey.[1] The isoradic contours are the result of a stationary point survey on a 330-ft. grid pattern. The medium-shade areas indicate the highest probability of production. The uncolored areas are questionable or "neutral" and the dark areas are unfavorable.

The well location was chosen because of the agreement between the seismic and radioactive survey. This well, which was drilled to the Dutcher sand, encountered good oil saturation with considerable gas in three different zones. Due to legal entanglements, the ultimate productivity of this well is still unknown.

The total favorable area of this prospect is small and could probably accommodate no more than two wells. However, these results serve to illustrate the ability of a combined exploration approach to pin-point small favorable areas.

An isoradic map of another small prospect is shown in Fig. 6 surveyed by the stationary point technique on a 330-ft. grid pattern. This quarter section in Garfield County, North Central Oklahoma, was surveyed under rather adverse conditions. Due to several circumstances, this field work was conducted on foot using a battery-powered portable scintillator. So that data of any validity be obtained, the time requirement for this survey was excessive. Due to the equipment limitations, the resulting data still lacked the desired statistical resolution. Therefore, the resulting contours are not rigidly valid but may be described as qualitatively defining the radioactivity variations. The medium-shaded area may be described as most likely to produce; the light area may be considered "neutral" or unlikely to produce; and the dark area is definitely not recommended for drilling.

With no additional subsurface information, the location was chosen and drilled. The result was a 25-bbl. per day well at 1,850 ft. The foregoing procedure is not recommended in the search for oil. This example is presented to demonstrate that if circumstances demand, radiation surveying can be quite successful without using additional data.

The map (Fig. 8) resulted from a continuous traverse type of survey over old production in Wilbarger County, Texas. The area, which was producing from the Milham sand, was to be developed for water flooding. The isoradic contours on this half section were developed after the integration of the continuous field recordings over 200-ft. intervals.

Since most of this prospect was known to be productive, the medium-shaded areas may be described as "average" from the radioactive standpoint; that is, the sand conditions and oil saturation in this area were arbitrarily classified as "average." The dark areas may then be described as "poorer-than-average," while the light areas may then be termed "better-than-average."

During the subsequent development for water flooding, six new wells were drilled. Without exception, the combined consideration of sand thickness and oil saturation as determined by Micrologs agreed exactly with the prediction from the radioactive surveys. From the isopachous maps, the average sand thickness had been computed as 11 ft.

The new wells drilled in the "average" areas encountered between

10 and 15 ft. of saturated sand while those drilled in the "above average" areas encountered from 16 to 22 ft. of saturated sand. It is felt that the radioactive survey contributed materially to the efficient development of this property for secondary recovery.

A reproduction of a typical recording obtained in traversing a prospect is shown in Fig. 10. This pattern resulted from traversing the field shown in Fig. 9 from west to east near the north end. The very high intensities serving as the east anomaly limit are typical and indicative of major faulting. The less radical intensity increase limiting the anomaly on the west is indicative of the probable oil-water contact.

The trace of major faulting is depicted by the black lines. The shaded area represents the limits of probable production as shown by the radiation study. The dashes along the east edge of this area and in the fault trace represent an area of probable field extension apparently through the fault plane.

Survey control in this immediate vicinity was insufficient to give further definition to this prediction. It is natural that the proposal of this condition met with skepticism on the part of those familiar with this field. The subsequent drilling immediately east of this area, however, confirmed the accuracy of this unlikely prediction.

This well, drilled by a different operator, has been described as the "best well in the field." The explanation is a flattening of the fault plane and subsequent deposition of sand. As of October 1959, there had been 12 wells drilled within the traverse limits in complete agreement with the radiation-survey predictions.

A tool with definite uses. Radioactivity surveying has been a very controversial subject through the years. Much of this controversy has been due to a lack of knowledge, understanding, and cooperation on the parts of both radiation surveyors and exploration personnel using the information. Some of the problems are reminiscent of the days when seismic surveying was struggling for its recognition.

In pioneering for radiation survey acceptance, the conviction has been stressed that the technique is valid only when proper instrumentation is used. It is imperative that the interpretation is accomplished by the application of statistics and widespread experience. When these conditions are met, then an informed but unpredjudiced evaluation of the radiation results can lead to the acceptance of this technique as a constructive member of an integrated exploration team.

Reference

1. Seismic data courtesy of C. P. Durant, consulting geophysicist, Tulsa.

Sunray reports widespread success in drilling

In Oklahoma, Sunray Mid-Continent Oil Co. has finaled a triple completion in College Corner pool of Kingfisher County.

The 2 Stewart, C NE NE 27-19n-6w, flowed 288 bbl. of oil a day through 22/64-in. choke from Oswego formations at 6,261-70 ft., 116 bbl. of oil a day through 19/64-in. choke from perforations at 6,616-24 ft. opposite the Manning and 180 bbl. of oil a day through 19/64-in. choke from Meramec open hole at 6,820-7,005 ft. Total depth was 7,005 ft.

In North Dover pool of Kingfisher County, Sunray completed a dual oiler.

The 2 Winters, C NE SW 15-18n-7w, pumped 5 bbl. of oil a day from perforated intervals at 6,532-65 ft. in the Oswego. Manning perforations at 7,010-29 ft. and 7,042-55 ft. flowed 400 bbl. of oil a day through 14/64-in. choke. Tubing pressure registered 800 psi. The hole was drilled to 7,110 ft. with 5½-in. casing cemented at 7,104 ft.

New Mexico. Sunray has completed the No. 1 New Mexico State "Z," SE NE SE 2-29n-14w, San Juan County, flowing 250 M.c.f.d. of gas from Dakota perforations at 5,772-92 ft.

Texas. Sunray has opened production 1 mile north of Payday field in Jones County, West Texas.

The exploratory well, 1 Walker, Section 8, Block 4 H&TC RR Survey, is located 4 miles southwest of Stamford, Tex. Tests on the well pumped 62 bbl. of 41.2°-gravity oil a day from Swastika sand perforations at 2,632-42 ft. The hole was drilled to 2,924 ft.

California. Sunray and McCulloch Oil Co. have completed a new gas field discovery in California's northern Sacramento Valley.

The No. 1 T. E. Heidrick, 18-20n-2w, Glenn County, flowed 2,875 M.c.f.d. from Cretaceous "F" zone perforations at 3,655-80 ft. and 3,687-3,712 ft.

The well is located about 5 miles northeast of Willows, Calif. Nearest production is 2 miles southeast in Beehive Bend gas field, second-largest field in the Sacramento Valley, discovered by Sunray in 1952 and 2½ miles northwest in the Artois gas field opened by Sunray in 1959.

Sunray holds approximately 1,150 acres in the immediate vicinity of the discovery well.

South Texas. In McMullen County, Sunray has finaled two oilers on the J. P. Driggs lease, Section 103 BS&F Survey A-137.

The 6 Driggs pumped 125 bbl. of oil a day from Chernosky sand perforations at 2,208-28 ft. and the 5 Driggs pumped 44 bbl. of oil a day from perforations at 2,192-2,210 ft. opposite the Chernosky.

Harris County adds third Wilcox producer

Harris County in Southeast Texas has its third Wilcox producer. Standard Oil Co. of Texas 1 H. J. Longenbaugh 1 flowed 6,200 M.c.f.d plus 18.5 bbl. condensate per million from E-1 Wilcox perforations at 11,908-28 ft. Location is about 3,000 ft. southwest of the 1 Josey, a recent dual gas-condensate completion which opened the most coastward Wilcox production in Texas' coastal area. The two wells are 3½ miles southwest of Cypress in the HT&C Survey 25, A-432 and the W. C. Davis Survey 24, A-1334. The Josey well completed in D-2 and D-6 Wilcox sands from 11,135 to 11,360 ft. Nearest comparable production is 20-30 miles north in Lake Creek and Pinehurst fields, Montgomery County. There is, however, an old Wilcox producer in Harris County's Tomball field.

April multiple completions

	Dual oil	Dual gas	Triple oil	Triple gas	Triple gas/cond.	Dual gas/cond.	Triple oil/gas	Dual oil/gas	Quad. oil	Quad. oil/gas
Arkansas	2	5	...	...	...	...	...	...	...	...
Colorado	...	2	...	...	...	...	...	...	...	...
Kansas	...	...	...	...	...	...	1	...	...	...
Kentucky	...	...	1	...	...	...	...	...	...	...
Louisiana	37	6	8	...	...	...	1	7	1	1
South	25	4	3	...	...	...	1	4	...	1
Offshore	12	2	5	...	...	...	...	3	1	...
Mississippi	3	...	...	2	...	...	1	...	...	...
Nebraska	1	...	...	...	...	...	...	...	...	...
New Mexico	4	1	...	...	...	...	...	...	...	...
Oklahoma	17	3	5	...	...	3	1	10	...	...
Texas	38	20	12	6	2	5	2	11	5	1
Dist. 2	1	4	...	1	...	...	...	...	...	...
Dist. 3	14	2	6	...	2	5	1	2	...	...
Dist. 4	3	6	4	2	...	...	...	3	5	...
East	9	1	1	...	...	...	1	1	...	...
Dist. 7-B	2	...	...	1	...	...	...	...	...	...
West	8	3	1	...	...	...	...	...	...	...
Dist. 9	1	1	...	...	...	...	...	...	...	1
Dist. 10	...	3	...	2	...	...	...	4	...	...
Utah	1	...	...	...	...	...	...	1	...	...
Total U. S.	100	37	26	8	2	8	6	29	6	2

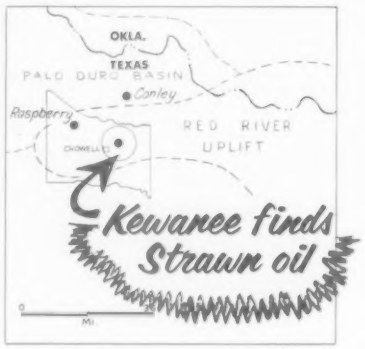
Total multiple completions, 224.

North Texas gets remote oil find

REMOTE oil production is apparent at a wildcat 20 miles southeast of Raspberry field, closest oil. The indicated discovery is Kewanee Oil Co. 1 Sandifer, Section 369, Block A, H&TC Survey, about 4½ miles east of Crowell in Foard County, North Texas.

Operator tested the Cisco, Canyon, and Strawn. Nine tests were made in the Strawn section. A test at 4,260-4,320 ft., open 4 hours, had gas to the surface in 28 minutes, oil in 2 hours, 15 minutes. Flow was 11.6 bbl. of oil in 1 hour, 20 minutes. Recovery was 3,700 ft. of free oil, 167 ft. mud-cut oil, 52 ft. heavily oil and gas-cut mud. IBHP was 1,830 psi., FBHP 1,820 psi.

Location of the discovery so far from production is significant. The Red River uplift is a buried structural feature extending along Red River from Denton County to Cottle County or beyond. The uplift is not a continuous ridge, but a series of scattered granite peaks along a fairly continuous upland, and it is blanketed by overlying Cretaceous and Paleozoic sediments. While the buried ridge has an east-west length of about 200 miles, its width is very little. There are isolated peaks, but for the most part, they occur in semiranges, separated by saddles; and spurlike ridges are known to cross the river into the Wichita Mountains of Oklahoma.



THE WESTERN END of the Red River uplift has an apparent Strawn Pennsylvanian oil discovery.

Two principal structural divisions of the uplift have been described: The Electra arch makes up the western part, lying in Clay, Wichita, Wilbarger, Foard, and Cottle counties; the eastern end, plunging southeastward through Denton, Cooke, and Montague counties, is known as the Muenster arch.

Some of the oldest and biggest fields in Texas are in this arch country. Petrolia (Henrietta) field was opened in 1904. Some of the other majors here are KMA, Hull-Sikes, and Burkburnett. Main pays are the Pennsylvanian, Mississippian, and Ordovician.

The new Strawn discovery is about 20 miles south of new multipay Conley field, Hardeman County.

Weatherby find in Texas taking production tests

The important Mobil Oil Co. 1 Weatherby, 1 mile east of the famed 1 Moore, Pennsylvanian gas discovery in northwestern Pecos County, 20 miles northwest of Fort Stockton, Tex., is testing in perforations at 15,117-15,210 ft.

The well flowed 7,500 M.c.f.d. through 40/64-in. choke and 65 bbl. condensate in 6 hours. This well when finished will confirm the Rojos Caballos field, opened last year at 1 Moore. Location is in Section 20, Block 48, T-8, T&P Survey.

New Mexico. Pure Oil Co. 1-L State-Lea, northwestern Lea County wildcat, 9 miles northwest of Lovington, is drilling ahead below 12,690 ft. in lime and shale after recovering gas-condensate on a drillstem test in Morrow Pennsylvanian at 12,610-76 ft. Location is 4 miles north of Townsend field.

PARTY 3 LAID OUT a refraction system in the northwestern corner of the Blackfeet Indian Reservation in Montana. Don Herman, right, aids operation of remote unit which bounced back signal sent by transmitter located near pole (arrow) on distant hill.

SENIOR SURVEYOR DOYLE CURTIS of Shell Oil Co., shows location of a remote unit which returns signal sent out by bowl-shaped Tellurometer. Left to right: Bill Briggs, Mike Johnson, Tellurometer operator, and Curtis.

New instrument eases survey work

RECENTLY Shell Oil Co.'s Party 3 was faced with the problem of laying out a refraction system in the northwestern corner of the Blackfeet Indian Reservation of Montana. The lines began on the common boundary between Glacier National Park and the reservatiton, extending several miles to the east over mountainous terrain.

Heavy timber created the problem of measuring distances between shot-point lines and geophone lines. One method involving United States Coast and Geodetic Survey triangulation into the area was considered but discarded as too slow and costly.

The answer. Shell solved its surveying problem by way of South Africa where a new surveying instrument has been proving itself for the past 4 years. Shell surveyors had seen impressive demonstrations of the new Tellurometer and decided that now was the time to put it into use in the Rocky Mountain region.

The unit resembles and operates much like radar, sending out microwaves and recording the elapsed time it takes for the signal to return from the remote unit to which it was directed. The services of a mapping company in Denver which uses the Tellurometer were obtained.

In 3 days, Shell and the Tellurometer measured 26 different lines varying from 2-15 miles.

In one series of lines the Tellurometer error was a mere 0.47 ft. in almost 45 miles. An error of less than ½ ft. in measuring 237,600 ft. is excellent. The Tellurometer cut Shell's surveying time in half. The time savings was not the only important aspect of the operation. Shell's important seismic work can now be done by using extremely accurate distance data supplied by the Tellurometer.

March footage breakdown in the U. S.

	Field wells					Wildcats			
	Oil	Cond.	Gas	Dry	Service	Oil	Cond.	Gas	Dry
Alabama	46,113								18,741
Alaska	43,807								
Arizona									6,749
Arkansas	92,444		9,142	68,077	3,476				20,572
California	440,281		68,488	68,018	13,570	10,656		24,254	149,352
Colorado	44,234		31,655	69,415				26,157	108,598
Florida									22,970
Illinois	89,966			34,242	82,091	8,458		578	38,263
Indiana	19,511			14,525		1,876		902	12,783
Kansas	429,633	2,715	50,574	165,984	64,826	39,425		31,369	284,810
Kentucky	52,558		56,483	92,817	3,072	2,700		2,711	18,756
Louisiana	1,204,035		455,129	647,760	8,920	28,209		84,321	470,758
North	114,794		79,892	78,460	2,750	18,878			87,693
South	883,370		345,124	462,293		9,331		84,321	334,325
Offshore	205,871		30,113	107,007	6,170				48,740
Michigan	59,920		3,960	42,400		2,607			42,940
Mississippi	166,918	9,701	26,920	83,796					126,913
Missouri									10,618
Montana	105,636			30,021		7,730			102,836
Nebraska	180,169			46,266		16,326			133,524
Nevada	7,755								
New Mexico	390,278		173,966	115,793	2,905	36,002		11,861	159,855
West	82,846		154,276	7,460					10,744
East	307,432		19,690	108,333	2,905	36,002		11,861	149,111
New York	19,875		7,673	2,650	14,575			3,048	15,428
North Dakota	43,466			26,475		8,210			44,744
Ohio	87,417		57,128	22,476	33,297			5,958	6,725
Oklahoma	898,670	9,279	321,661	353,738	172,897	54,894		16,436	170,626
Pennsylvania	35,112		73,396	23,649	16,860				
Texas	2,472,625	413,224	321,595	832,547	30,728	102,006	64,625	41,037	960,700
District 1	51,048		452	19,235	3,700		12,574	6,025	130,684
District 2	161,371	79,480	32,308	54,600				17,931	29,469
District 3	229,975	78,536	22,291	146,445			14,005	11,733	77,701
District 4	195,789	77,978	28,185	180,812			5,580		87,958
East	256,120	57,324		72,592		10,527	7,643		104,477
District 7-B	210,931		16,641	96,176		32,090		5,348	149,877
West	964,527	60,703	25,532	83,561	8,679	42,340			270,148
District 9	209,744	52,250	4,101	117,002	18,349	8,544	5,785		77,683
District 10	193,120	6,953	192,085	62,124		8,505	19,038		32,703
Utah	95,353		5,460	7,427				9,441	40,393
Washington									4,482
West Virginia	10,612		164,129	20,157	406				14,737
Wyoming	203,848	7,228	18,395	93,953	4,991			8,357	193,540
Total U. S.	**7,240,236**	**442,147**	**1,845,754**	**2,862,186**	**452,614**	**319,099**	**64,625**	**266,430**	**3,180,413**

. . . and in western Canada

Alberta	345,258		101,988	105,041	18,050	58,813		58,303	174,492
Saskatchewan	102,020			27,938	3,289	15,792			9,828
Manitoba	7,936				2,000				
British Columbia	9,010		22,280	8,439		3,775		35,427	47,418
Northwest Territories								8,771	7,600
Total	**464,224**		**124,268**	**141,418**	**23,339**	**78,380**		**101,501**	**240,338**

Wyoming's Frenchie Draw discovery flows gas

A Fremont County wildcat in Wyoming flowed 2,176 M.c.f.d. on drill-stem test at 8,416-46 ft. The wildcat is Humble 1 Frenchie Draw unit, NE SE 21-37n-89w. Test was best in eight drill-stem tests. Location is 3½ miles northeast of the shut-in gas well at Squaw Butte unit. The Frenchie Draw wildcat is slated as a 10,000-ft. Lance Upper Cretaceous test. No tops have been released.

Discovery wells

WEST CENTRAL TEXAS

Stephens County:

Fletcher Oil & Gas Drilling Corp. 1 Joe Winston, 4 miles east of Caddo in Sec. 33, Blk. 4, T&P Sur., 2½ miles south of Pharris multipay field. IPF 114 BOPD, 16/64-in. choke, 38°, GOR 270:1, CP 660 psi., TP 320 psi., Conglomerate 3,904-8 ft. TD 4,122 ft. New oil discovery.

WEST TEXAS

Andrews County, Hutex-Bend field:

Humble Oil & Refining Co. 4-AL State University, 18 miles northwest of Andrews in Sec. 14, Blk. 8, Univ. Lands Survey. IPF 68 BOPD, ¼-in. choke, 44.8°, GOR 4,009:1, TP 300 psi., packer. Bend 11,787 92 ft. TD 12,585 ft. New oil discovery.

Gaines County:

Amtexas Oil Corp. 1 H. Hinkle et al., 3 miles north of Seminole in Sec. 166, Blk. G., WTRR Sur. IPP 35 BOPD plus 50% water, 32°, San Andres 5,470-5,540 ft. TD 5,710 ft. New oil discovery.

Lynn County:

Earl Wells 1 Coleman, 3½ miles east of Wilson in Sec. 1, Blk. L, GWT&P Sur. IPP 109 BOPD, plus 17% water, 36°, GOR 450:1. San Andres 4,249-54 ft. TD 4,700 ft. New oil discovery.

Martin County:

Husky Oil Co. 1-A Hill, 19 miles north of Stanton in Sec. 62, Blk. A, Bauer & Cockrell Sur. IPF 247 BOPD plus 2% water, 20/64-in. choke, 36.2°, GOR 555:1, TP 100 psi., packer. Dean 8,462-8,502 ft. TD 11,170 ft. New oil discovery.

DISCOVERY WELLS

CALIFORNIA

Kern County:

Texaco Inc. 1 B-L-H Gas Unit One SW NW SW 22-26s-22e. Completed flowing 1,460 M.c.f.d. through ¼-in. choke with a flowing pressure of 913 psi. Perforations at 2,735-37¼ ft. in Mya sands (Upper Cretaceous). TD 4,204 ft. Discovery well 4 miles northwest of Semitropic gas field.

OKLAHOMA

Alfalfa County:

Continental Oil Co. 1 W. W. Armbruster, SW SE SE 3-28n-11w, 1 miles south of Burlington. IPF 126 BOPD, 72 M.c.f./18 hours, 20/64-in. choke, FTP 275 psi., GOR 1,081:1, 32.5°, Red Fork sand 5,156-66 ft. TD 5,908 ft. New oil discovery.

Dewey County:

Humble Oil & Refining Co. 1 Willis Barnes, 3 miles northwest of Northwest Webb field in C NW SE 34-18n-19w. IPF 1,300 M.c.f.d., 137 BOPD, 33/64-in. choke, FTP 1,042 psi., SIP 2,720/14 hours, 50.6°, Oswego 9,315-58 ft. TD 9,520 ft. New gas-condensate discovery.

NORTH TEXAS

Jack County:

Brown Oil Co. 1 J. C. Pigg, 7 miles east of Newport in J. G. Goad Sur. 1093. IPF 132 BOPD, 22/64-in. choke, 42.5°, GOR 1,185:1, TP 40 psi., packer, Bend Conglomerate 5,993-6,025 ft. New oil discovery.

SOUTH TEXAS

Nueces County:

South Ramada field. Ramada Oil & Gas Co. 3 J. O. Moore, 5 miles south of Violet in Sec. 143, Braniger Bros. Subd. of Clarkson Ranch, IPF 141 BOPD, no water, ⅛-in. choke, 2,800-ft. Miocene 2,886-96 ft. TD 3,112 ft. New oil discovery.

WEST TEXAS

Concho County:

Sunray Mid-Continent Oil Co. 1 R. L. Carter, 8 miles northwest of Eden in Sec. 157, Blk. 72, T&N Survey. IPP 70 BOPD, plus 44 bbl. water, 41°, GOR 1,500:1, Canyon sand 3,191-3,206 ft.; IPF 185 BOPD, 12/64-in. choke, 46.2°, GOR 638:1, CP 900 psi., Strawn lime 3,574-88 ft. TD 3,992 ft. New dual oil discovery.

Hockley County:

Ohio Oil Co. 1 Vinnie C. Linker, 4 miles south of Levelland in Lab. 21, Lge. 30, Baylor CSL Sur. IPF 207 BOPD, 32/64-in. choke, 27.5°, TP 20 psi., packer, lower Clearfork 7,368-69 ft. TD 8,505 ft. New oil discovery.

Kent County:

Ohio Oil Co. 1 Nellie McLaury A/C 1, 5 miles northeast of Clairemont in W. P. Wilson Sur. 7, 2 miles northeast of North Clairemont field. IPF 239 BOPD, 20/64-in. choke, 39.5°, GOR 466:1, TP 110 psi., CP 10 psi., 6,605-7 ft. New discovery.

Ward County:

Gulf Oil Corp. 56 W. A. Estes, 9 miles northeast of Grandfalls in Sec. 4, Blk. B-28, PSL Sur. IPF 87 BOPD, 25/64-in. choke, 35.5°, GOR 6,486:1, TP 180 psi., CP 490 psi., Devonian 6,300-16 ft. TD 6,693 ft. New oil discovery.

Yoakum County:

Sunray 1-A Mattie Powell, 9 miles east of Plains in Sec. 4, Blk. D, J. H. Gibson Sur. IPP 86 BOPD, plus 1% water, 29.7°, GOR 198:1, Abo 8,300-5 ft.; IPP 206 BOPD, 31°, GOR 290:1, upper Clearfork, 6,600-6,718 ft. TD 8,530 ft. New dual oil discovery, second Abo producer in Texas.

Texaco Inc. 1 Ruth Bennett, NCT-3, 8 miles northeast of Denver City in Sec. 694, Blk. D., John H. Gibson Sur. IPP 227 BOPD, 28.1°, GOR 199:1, Wichita Albany 8,136-46 and 8,226-34 ft. TD 8,250 ft. Dual oil discovery. IPP 208 BOPD, 28.1°, GOR 199:1, Clearfork 7,836-8,048 ft.

TEXAS PANHANDLE

Ochiltree County:

Blanchard Drilling Co. 1 Nuefield, 4 miles west of Perryton in Sec. 63, Blk. 11, W. Ahrenbeck Sur. IPF 1,475 M.c.f.d., 55° GLR 130,000:1, TP 1,185 psi. SIP 2,536 psi., Morrow 7,940-50 and 8,036-38 ft. TD 8,157 ft. New gas-condensate discovery.

Jack Grace Producing Co. 1 Cudd unit, Smith-Perryton Lower Morrow field, 4 miles west of Perryton in Sec. 65, Blk. 11, W. Ahrenbeck Sur. IPF 316 BOPD, 48/64-in. choke, 36.5°, CP 25 psi., TP 75 psi., GOR 240:1. Lower Morrow 8,308-24 ft. TD 8,505 ft. New oil discovery.

New gas discovery finaled in Louisiana

Iberville Parish got new gas production at F. A. Callery 1 L. N. Folse, ¾ mile west of Laurel Ridge field.

The well flowed 3,200 M.c.f.d. and 100 bbl. of oil through 14/64-in. choke from perforations at 10,722-26 ft. Location is in 17-10s-13e.

Plaquemines Parish. Gulf Oil Corp. is still testing at C-1 Mark Delesdernier, new wildcat discovery in 5-23s-31e. The well gaged 346 bbl. of oil daily from an 11-ft. pay sand topped at 8,670 ft. Location is 1½ miles east of West Bay field.

Remote Kansas discovery reported in Finney County

Remote oil production is assured at Cities Service Petroleum Co. 1 Cowgill "A," C NW SE 27-24s-33w, 9 miles northeast of Pleasant Prairie field and 2¾ miles southwest of Garden City.

The well got 1,535 ft. of free oil, 120 ft. of heavily oil and gas-cut mud, 60 ft. of mud, and 4,100 ft. of gas in the pipe from a drill-stem test in the Marmaton Pennsylvanian at 4,804-25 ft. Location is 10 miles northeast of Ivanhoe field, 9 miles southeast of Sequoyah field, and 11½ miles northwest of Beyer field in southwestern Kansas.

This announcement is neither an offer to sell nor a solicitation of an offer to buy any of these Debentures. The offer is made only by the Prospectus.

$100,000,000

Continental Oil Company

4½% Debentures Due 1991

Dated May 1, 1961 *Due May 1, 1991*

Interest payable May 1 and November 1 in New York City.

Price 99¼% and Accrued Interest

Copies of the Prospectus may be obtained in any State from only such of the undersigned as may legally offer these Debentures in compliance with the securities laws of such State.

MORGAN STANLEY & CO.

BLYTH & CO., INC. *THE FIRST BOSTON CORPORATION*

EASTMAN DILLON, UNION SECURITIES & CO. *GOLDMAN, SACHS & CO.*

HARRIMAN RIPLEY & CO. Incorporated *KIDDER, PEABODY & CO.* *LAZARD FRERES & CO.*

LEHMAN BROTHERS *MERRILL LYNCH, PIERCE, FENNER & SMITH Incorporated*

SMITH, BARNEY & CO. Incorporated *F. S. SMITHERS & CO.*

STONE & WEBSTER SECURITIES CORPORATION *WHITE, WELD & CO.*

DREXEL & CO. *LEE HIGGINSON CORPORATION*

SALOMON BROTHERS & HUTZLER *DEAN WITTER & CO.*

May 3, 1961.

Paul Thibodaux . . . 45 years of pipelining.

Veteran Pipeliner Sums Up

- Paul Thibodaux lists his contributions to Burden Construction as a dash of engineering, lots of hard work.

FEW businessmen relax in quite the same manner and degree as Paul "Tib" Thibodaux, executive vice president of O. R. Burden Construction Co. Almost every workday noon, Thibodaux heads for a well-stocked pond on company property in Tulsa to try his hand at a little fly casting.

Fly fishing is a reflective sport. It gives Thibodaux a chance to think about company affairs in an atmosphere free of distraction.

Those "affairs" might include the 400 miles of pipeline his company is laying in Iraq or preparations to build a 267-mile gas line to supply San Antonio.

Burden is a versatile organization. In 1954 it set an apparent record by completing 335 miles of 22 and 24-in. line for Service Pipe Line in 60 days. This period covered the entire job, from right-of-way to testing.

By way of contrast, Burden has taken up more than 4,000 miles of pipeline, hitting a maximum rate of 11 miles of 12-in. pipe daily with a single spread.

The company's flexibility is proved by a glance at the roster of its wholly or partially owned subsidiaries.

Burden International, Ltd., is set up to do drilling and pipelining in the Eastern Hemisphere. Burden Drilling and Pipe Line Contractors, GB, Ltd., put two rigs in Libya to drill for Shell. Turrif-Burden, Ltd., organized to build pipelines in the Middle East, is now working on the 400-mile pipe-laying job for Iraq Petroleum Co.

Universal Engineers & Constructors, Inc., handles engineering on refinery, chemical, gas, and liquid-oxygen projects.

Constructora Burden de Mexico, SA, is set up to operate in Mexico, and Burden Panamerica, Inc., is prepared to operate elsewhere in this hemisphere.

Texas Central Gas Co. was organized to build gas-transmission lines. Tulsa Minerals Co. specializes in mining, and Phoenix Constructors, Inc., is an earth-moving company.

Thibodaux is an officer of each of these companies as well as the parent company, which was organized in 1949.

At that time Thibodaux and the late Oscar R. Burden formed the most lasting of their several associations. They had met in 1919 when Thibodaux went to work for The Texas Co. with Burden as his foreman.

Career climb . . . In 1926 Thibodaux left Texas to go with a Benedum-Trees operation that was later absorbed by one of the predecessor companies of Cities Service.

One of his jobs with Cities Service involved the conversion of a crude line to products. It was in the early 1930's and there was little precedent to go by but the job was successfully completed.

Later Thibodaux became general superintendent in charge of pipelines and crude purchases for Arkansas Fuel Oil Corp. and Arkansas Pipe Line Co.

Burden and Thibodaux were reunited as a team in 1942 when the War Emergency Pipeline was begun. Burt Hull appointed Burden general

▶▶▶ Personals

R. Keith Walden, Tucson, has been named vice chairman of the Arizona Oil and Gas Commission. He succeeds the late M. F. Wharton.

D. C. Ion, general manager of Triad Oil Co., Calgary, has joined BP Exploration (Canada) as Calgary representative. **F. A. McKinnon,** exploration manager of Triad, will succeed Ion. Ion will continue as a director of Triad.

Claude K. Rice, analytical and testing-section coordinator in Gulf Oil's Philadelphia refinery technology laboratory, has received the 1961 Max Hecht award of American Society for Testing Materials. The award recognizes Rice's work in the field of water technology.

Ross H. Faulkner has joined Mobil Oil Co. as acquisitions adviser to the vice president for exploration and producing. He will headquarter in New York.

Fred Zapffe has joined Foor Engineering Co., Oklahoma City, as chief engineer. He had been responsible for design of compressor and gas-processing facilities for Lone Star Gas Co.

superintendent in Cincinnati. Thibodaux became Burden's assistant.

Hull, previously head of pipelines for The Texas Co., was ramrodding the Trans-Arabian pipeline and asked Burden to be his assistant. Burden agreed if Thibodaux could go with him. They ended up as manager and assistant, respectively, in the project's Beirut office.

Louisianan . . . Thibodaux was born on his grandfather's plantation at Bell Rose, La., where the family had lived since the Acadian migration from Nova Scotia. His formal education ended at 15 when he graduated as valedictorian from a boys' school run by the Brothers of the Sacred Heart in Donaldsonville, La.

The brothers had stressed mathematics and Gregg shorthand, and Thibodaux was able to start work as a court reporter. He wanted to go into law, but gave up the hope and went to work for The Texas Co. in December 1916. That first oil job was short-lived. He enlisted in the Army April 6, 1917, the day the U. S. declared war on Germany.

Thibodaux was discharged in 1919 as a sergeant major in a mounted machine-gun troop, and returned to The Texas Co.

How would Thibodaux outline his contributions to the Burden company?

"A little engineering and a lot of hard work," he says.

He came by his engineering knowledge the hard way—through correspondence courses in civil, mechanical, and petroleum engineering. It was sound knowledge, for it enabled him to help assemble and edit several manuals on petroleum engineering.

The "hard work" includes every Saturday and many Sundays at the office.

R. C. Alden, retired research director of Phillips Petroleum Co., and **W. J. Sweeney,** vice president of Esso Research & Engineering Co., will receive certificates of appreciation at the midyear meeting of API's Division of Refining May 8-11 in Houston. Three oil marketers will receive certificates of appreciation during the Marketing Division's midyear meeting May 16-19 in Bal Harbour, Fla. They are **R. Cubicciotti,** Witco Chemical Co.; **J. L. Minner,** Shell Oil; and **Willard W. Wright,** Sun Oil.

A. K. Haggard, superintendent of operations for BBM Drilling Co., Houston, has been elected a director of the company.

W. M. (Bill) Barnhart, Bland & Barnhart Drilling Co.; **L. C. Powell,** Ohio Oil; and **R. L. Manning,** R. L. Manning Co., received citations for service at the annual meeting of the Rocky Mountain district of API's Division of Production last week.

A. S. Williamson, Calgary, is president of Norsul Oil & Mining, Ltd., new Canadian company formed by reorganization of the old Aldina-Leduc Oil Co. **Howard Steven Strouth** is chairman and general manager. **Mrs. M. G. Bleaken** is secretary-treasurer. Directors include Williamson, Strouth, Mrs. Bleaken, **H. C. A. Swolfs,** and **Paul Bock.**

Don W. Franklin, West Texas-Southeast New Mexico district geologist for Ohio Oil Co. in Midland, Tex., has been promoted to assistant division geologist in Houston. **John W. Higgins,** area geologist in Roswell, N. M., will succeed Franklin in Midland. Higgins will be replaced by **Nelson Webernick,** area geologist in Midland. **Julian Walker,** Amarillo, Tex., area geologist, will move to Midland to succeed Webernick.

Four geographic districts formed in reorganization of Ohio Oil's products-distribution division are the Ohio, Tri-State, Lake Michigan, and Detroit. **A. J. Moorhead** is manager of the Ohio district and **H. E. Bogart** is assistant manager. They will headquarter in Findlay. **W. O. Seabury, Jr.,** is Tri-State district manager in Indianapolis. **L. R. Hooper** is assistant manager. Lake Michigan district manager in Des Plaines, Ill., is **H. W. Collins. T. C. Buchanan** is assistant manager. **I. R. Schiff** is Detroit manager with **F. W. Schuessler** as assistant. Also, a new lube oil and grease department has been set up with **A. S. Hagen** as manager and **C. T. Oxley** as assistant. **M. D. King** is manager of the products-distribution division, and **L. R. Snyder** is assistant division manager.

▶▶▶ Personals

C. E. Boone, vice president and a director of Amerada Petroleum Corp., has been named executive vice president of the company. **Albert Taylor,** executive assistant, has been elected a vice president. Boone

BOONE

TAYLOR

was division manager in charge of Amerada's West Coast and Canadian operations before being named a vice president in 1952. He has headquartered in Tulsa since 1955. Taylor became executive assistant last year after serving as manager of the gas department.

George la Perle, formerly regional geologist for Richfield Oil Corp. in Bakersfield, Calif., and **Joe Johnson,** Shell Oil geologist, have formed Geo-Research Corp., Bakersfield consulting firm.

Harold A. Ricards, Jr., head of distribution and exploratory research for Humble's Esso division in New York, has been appointed assistant manager of economic and marketing research. He succeeds **Forrest H. Blanding,** who has been transferred to Standard Oil Co. (N. J.), the parent company.

E. B. Miller, Jr., vice president of Tidewater Oil Co. and general manager of its southern division, has been elected president of the Petroleum Club of Houston. He succeeds **Herbert F. Beardmore,** Gulf Oil vice president. Other new officers are **F. W. Bell,** Brown & Root, first vice president; **Raybourne Thompson,** attorney, second vice president; **Wallace C. Thompson,** General Crude Oil Co., third vice president; **Vernon Frost,** independent, treasurer; and **Amos A. Roberts,** Baroid division of National Lead Co., secretary. New directors include Frost, Roberts, Wallace Thompson, and **C. W. Alcorn,** Falcon Seaboard Drilling Co.

▶▶▶ Personals

Joseph A. Stoll has been elected vice president for supply and transportation by Standard Oil Co. (Ohio); **Everett C. Hughes** has been elected vice president, research; **Robert W. Haigh** has been named vice president for planning; and

STOLL

HUGHES

HAIGH

MARTIN

Ralph A. Martin has been named vice president and controller. Stoll became manager of combined supply, distribution, crude-oil purchases and sales and transportation activities last month. He has been with the company 35 years. Hughes has been manager of the research department since 1959. Haigh, a former vice president of Helmerich & Payne, recently joined Ohio Standard as director of planning. Martin has been controller since 1948.

William J. Sheridan, manager of Humble's Everett, Mass., refinery, has been transferred to the Bayway refinery, Linden, N. J., as manager. He succeeds **Ross W. Murrell,** who has been given an assignment with Standard-Vacuum Oil Co. **J. J. Coates,** manager of the Pittsburgh grease plant, will succeed Sheridan at Everett. **Robert B. Winkel,** operations superintendent of the Bayonne, N. J., refinery, will succeed Coates in Pittsburgh. Winkel's appointment sets off a number of changes at Bayonne. **Richard Preston,** head of the manufacturing department there, will succeed Winkel as operations superintendent. **Richard B. Nerf,** head of the technical department, will succeed Preston. **Robert L. Ross,** head of the terminaling department, has been named head of a combined technical and coordination department. **Rufo Sanchez,** coordination department head, will be head of the terminaling department.

James B. Devlin, geological engineer with Continental Oil Co., has joined Oil Property Management, Inc., Wichita, as vice president in charge of exploration.

Arlen L. Edgar, engineer with Pan American Petroleum, has joined Leibrock, Landreth, Campbell & Callaway, Midland, Tex., petroleum engineering consulants. He will work with reservoir performance and secondary recovery studies.

George B. Burris, general superintendent of drilling and production for Ray Smith Drilling Co. in Midland, Tex., has been promoted to vice president and general manager. Burris has been with the company since 1954.

Donald G. Clark, manager of gas sales for Trans-Canada Pipe Lines, has been named vice president of sales. **George W. Woods,** treasurer, has been named vice president and treasurer.

William C. Keefe, secretary of Panhandle Eastern Pipe Line Co. and its subsidiary, Trunkline Gas Co., has been elected vice president and secretary of both companies.

A. J. Morris has been elected vice president of supply and transporation for Crown Central Petroleum Corp. He will headquarter in Baltimore. Morris also is president of Crown Central's pipeline subsidiaries.

Arthur George Sprawka, senior field engineer with Arapahoe Pipe Line Co. in Ellinwood, Kans., has been promoted to superintendent in Ellinwood.

Smiley Raborn, Jr., executive vice president and managing director of Canadian Delhi Oil Ltd., Calgary, has been elected a director of Trans-Canada Pipe Lines. Other new directors are **W. P. Scott,** Wood, Gundy & Co., Toronto, and **Wilfrid Gagnon**, Dow Brewery, Montreal.

I. J. Pierce, exploration manager for Reading & Bates, has been elected vice president in charge of exploration. **DeWitt L. Potter,** Asiatic - Pacific geological coordinator for Phillips Petroleum in Bartlesville, Okla., has joined Reading & Bates as exploration geologist. Pierce also was with Phillips before joining Reading & Bates in 1958.

PIERCE

C. G. Drescher, coordinator of foreign market development for Sinclair Oil Corp., has been elected a director of Sinclair Venezuelan Oil Co., a subsidiary. He succeeds **C. R. Campbell,** who has retired.

B. F. McEvoy, technical manager in Spencer Chemical Co.'s plastics division, has been named assistant to the division vice president. **Dr. Edward T. Severs,** formerly with AviSun Corp., will succeed McEvoy.

Wayne F. Burke, manager of Ohio Oil's Michigan marketing district in Lansing, has been named assistant manager of the Indiana marketing district, Indianapolis. **Joseph B. Crowley,** Michigan sales manager, will succeed Burke. **Fred B. Knapp,** manager of the Muncie, Ind., marketing zone, will succeed Crowley.

Claude Williams has been named exploration and land supervisor in Atlantic Refining Co.'s new western region, Midland, Tex. **Raymond E. Howard** has been named regional engineering supervisor and **B. B. Coester** and **Lee B. Park** have been named regional geologists. In Atlantic's new south Permian district, also headquartered in Midland, **Richard L. McAlpine** has been named production superintendent. **E. W. Tyler** has been named district engineer and **Charles Wynne** has been named district land man. **E. T. Hill** has been appointed district geologist and **M. L. Mills,** district drilling engineer. **Jack O. Anderson** has been named superintendent of the Block 31 pressure maintenance and gasoline plant.

▶▶▶ Personals

L. E. Cranston, assistant manager of Mobil Oil Co.'s Beaumont, Tex., refinery, will become general manager of the refinery June 1. He succeeds **R. G. Sanders,** who is retiring. Cranston has been with Mobil since 1931.

Humble's new southeastern region office in New Orleans has announced several appointments in its four area offices in New Orleans, Jackson, Miss., Memphis, and Charlotte, N. C. Area managers named are, New Orleans, **T. J. Fuson,** formerly Houston area production manager in the southwest region; Jackson, **R. W. Gemmer,** formerly Billings, Mont., area manager in the central region; Charlotte, **H. R. Dowd,** formerly manager of Esso's Carolinas area; and acting Memphis manager, **F. P. Horton,** formerly assistant of Esso's Tennessee-Arkansas area. In the New Orleans area **P. M. McFadden** has been named production manager, **J. E. Lewark** has been named exploration manager, and **P. V. Rome** has been named marketing manager. In the Jackson area **J. D. Exner** will be production manager with **F. D. Richardson** as exploration manager. **J. L. Hiller** has been named acting manager of marketing in Charlotte.

D. H. Falkingham, Casper, Wyo., division engineer for Pan American Petroleum, has been named Billings, Mont., district superintendent. He succeeds the late C. E. Johnson. **A. M. Roney,** Billings district engineer, will replace Falkingham as division engineer in Casper. **F. K. Krebill,** senior petroleum engineer in Casper, will succeed Roney in Billings.

H. A. Eddins, president of Oklahoma Natural Gas Co., has been elected president of Southern Gas Association. Other officers are **Clayton L. Nairne,** New Orleans Public Service, first vice president; **Buell G. Duncan,** Piedmont Natural Gas Co., second vice president; **Jack A. Bell,** Gas Light Co. of Columbus, secretary; **B. F. Wombacker,** Southern Union Gas Co., treasurer; **W. C. McGee, Jr.,** Tennessee Gas Pipeline Co., chairman of the advisory council; and **Hugh F. Steen,** El Paso Natural Gas Co., vice chairman. New directors are **James J. Chaisson, Jr.,** Southern Cross Corp.; **John F. Pidcock,** South Atlantic Gas Co.; **John C. Parrott,** Roanoke Gas Co.; **J. C. Reid,** Southern Union Gas Co.; and **M. V. Cousins,** United Gas Pipe Line Co. **H. N. Oldham,** Pioneer Natural Gas Co., was elected to fill an unexpired term on the board and **Dan L. Hill,** Western Gas Service Co. was reelected a director.

EDDINS

Joseph L. Statman has been named manager of distribution and exchanges for Texas City Refining, Inc.

V. L. Crackel, geologist with Gulf, has been transferred to Salt Lake City from Durango, Colo. **Alva Glidewell,** Durango geologist, has moved to Ely, Nev.

Dr. Albert W. Musgrave, superintendent of special geophysics problems for Mobil Oil Co. in Dallas, has been named 1961 recipient of Colorado School of Mines' van Diest gold medal. The award recognizes Musgrave's work in the early 1950's in designing a pioneer analog computer for use with seismic reflection interpretation.

▶▶▶ Deaths

J. Steve Anderson, Sr., 75, one of the founders of the old Anderson-Prichard Oil Corp., died April 29 at his home in Oklahoma City. Anderson and L. H. Prichard founded the oil company in 1921 in Oklahoma City. Anderson sold his interest and resigned as vice president in 1946. Anderson - Prichard was sold in 1960 and a new firm, Apco Oil Corp., was set up by company executives.

Thomas A. Jirik, president of Cedar Creek Oil Co., Faribault, Minn., died April 24 in Chelsea, Okla., while on a trip to inspect one of his company's water floods. Jirik was Independent Petroleum Association of America's vice president for Minnesota.

Herman B. Hendershot, 74, president and treasurer of Hendershot Tool Co., died April 26 at his home in Oklahoma City. Hendershot was with Hinderliter Tool Co. in Tulsa before moving to Oklahoma City in 1945.

James Smith Loftin, land manager and general manager for the L. A. Grelling interests, died April 21 in a Tyler, Tex., hospital after a long illness. Loftin had been with H. L. Hunt and John W. Mecom before joining Grelling in 1950.

Frank G. Moore, 65, retired general traffic manager for Columbia-Southern Chemical Corp., died April 29.

Martin L. Eckley, 81, retired pipeline superintendent for the old Deep Rock Oil Corp., died April 29 in a Sapulpa, Okla., hospital.

Joseph F. Sullivan, 63, advertising manager of Brown Instruments division of Minneapolis-Honeywell Regulator Co., for many years, died April 24 of a heart attack. He was advertising production manager of Honeywell's industrial-products group at the time of his death.

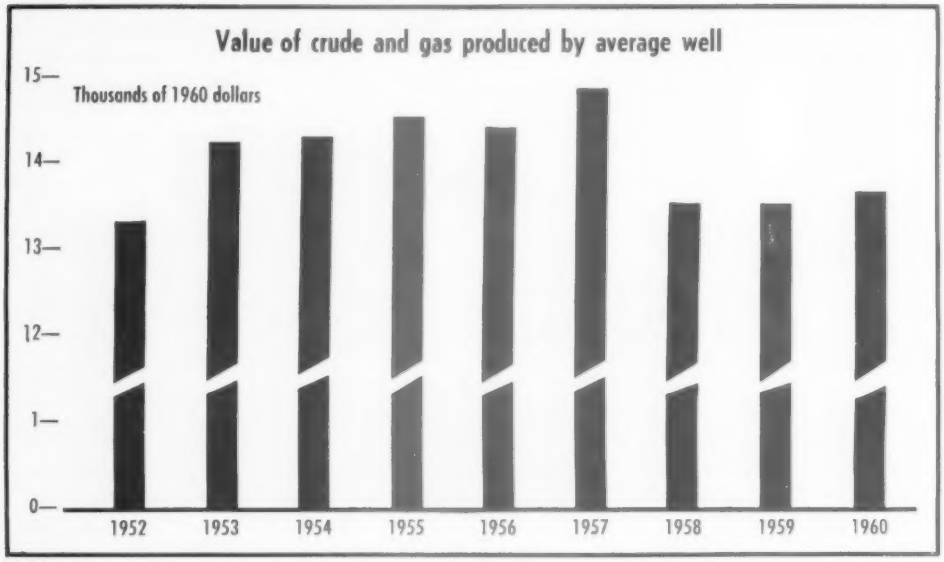
Walter S. LaFaber, 84, retired field superintendent for Reader & Peavey Oil Co., died April 15 in a Marietta, Ohio, hospital.

Fred B. Ropkey, 88, retired Tulsa attorney who represented the old Waite Phillips Oil Co., died April 27 in a Tulsa hospital after a short illness.

Gilbert Pollard, 45, general sales manager of Milwhite Mud Sales Co., died recently in Houston. Pollard had been with Milwhite 6 years.

Harold E. Bradenberg, retired division chief scout for Gulf in Tulsa, died April 28 at his home in Tulsa. Bradenberg retired in 1956 after 40 years with Gulf.

Scott R. Lewis, 73, Shippenville, Pa., oil producer, died April 29 in a Clarion, Pa., hospital.



BARS represent value of crude and gas produced by the average well each year. Value is corrected for inflation and expressed in 1960 dollars. Total value of crude and gas for a given year is divided by the average number of oil and gas wells operating that year. Value does not include gas liquids from plants.

Gross income per well needs a boost

BY JOHN C. CASPER

PRODUCER INCOME per well has been down for the past 3 years. The last big year was in 1957. That was the year when the industry had its last general crude-price increase and when production was up in the first half to meet export demands during the Suez crisis. The industry also produced 60 million barrels for storage that year. All of these factors contributed to the high income per well in 1957.

Over the past 3 years, the number of producing wells has increased faster than income from oil and gas.

Last year, the average well in this country produced about $13,730 worth of oil and gas. The postwar record in 1957 was $14,900 per well.

Several factors contribute to the changes in income per well. First, the number of producing wells has increased every year since the end of World War II. Wells operating in 1946 averaged 480,000. The total was up to about 672,000 for 1960.

Second, total production of oil and gas has been increasing since the end of the war. Marketed production of natural gas has shown a gain every year. Crude production has increased for all but four years of this period.

Third, true gas prices have increased since the end of the war, but crude prices haven't kept pace with inflation.

Gas prices changed just about enough to cover inflation in the early postwar period from 1946 through 1952 but have moved up faster in recent years. In 1960-value dollars, gas sold for 8.8 cents per M.c.f. in 1952. The average price was up to 13.6 cents in 1960.

On the other hand, crude prices over the past 12 years have not increased enough to cover inflation. Expressed in 1960-value dollars, crude was bringing $3.23 per barrel in 1948. The average price last year was $2.92 per barrel.

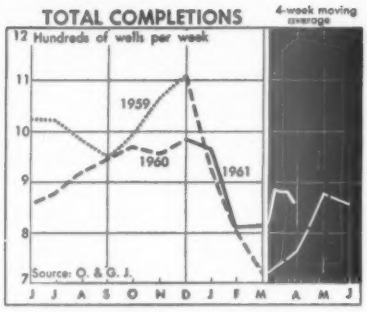
Fourth, consumption of low-priced gas is gaining faster than crude. In 1952, gas accounted for 38.4% of crude-gas production. By 1960, gas accounted for 46.9% of the total.

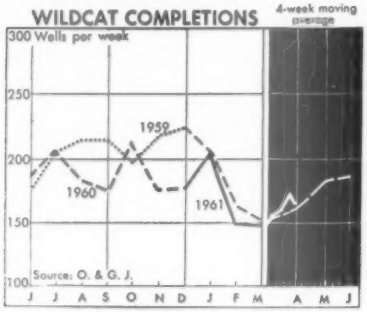
It all adds up to lower income per well. Increased drilling costs must be balanced by higher prices or more production per well or both.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,263,100	DOWN	5,575	UP	227,762
Crude stocks	249,378,000	UP	4,674,000	DOWN	12,547,000
Completions	849	UP	17	UP	77
Refinery runs	7,738,000	DOWN	27,000	DOWN	207,000
Gasoline stocks	219,317,000	DOWN	2,908,000	DOWN	207,000
Kerosine stocks	26,226,000	DOWN	221,000	UP	6,212,000
Distillate stocks	84,008,000	DOWN	614,000	UP	2,633,000
Residual stocks	41,275,000	DOWN	516,000	UP	1,955,000
Four-product stocks	370,826,000	DOWN	4,259,000	UP	10,593,000
Total imports	1,748,300	UP	109,700	UP	10,200

Active Rotary Rigs





	5-1-61	4-24-61	5-2-60
Alabama	5	5	3
Alaska	9	9	5
Arkansas	13	13	11
Arizona	0	0	3
California	83	76	96
Land	80	72	91
Offshore	3	4	5
Colorado	17	21	28
Florida	0	0	1
Land	0	0	0
Offshore	0	0	1
Georgia	2	2	0
Illinois	29	26	54
Indiana	9	12	9
Kansas	109	107	115
Kentucky	8	5	6
Louisiana	279	281	280
North	38	40	33
S. Inland waters	106	106	112
S. Land	78	71	78
Offshore	57	64	57
Michigan	18	16	29
Mississippi	50	50	70
Missouri	1	1	1
Montana	14	19	20
Nebraska	37	33	20
Nevada	1	1	0
New Mexico	109	101	122
New York	0	0	1
North Dakota	13	14	14
Ohio	7	7	4
Oklahoma	213	199	191
Pennsylvania	9	12	15
South Dakota	1	0	0
Texas	622	592	629
S. Inland waters	7	5	11
S. Land	169	170	156
Offshore	2	2	1
North	60	57	43
Panhandle	51	49	50
East	64	58	61
West Central	164	150	188
West	105	101	119
Utah	24	24	24
Washington	1	1	0
West Virginia	5	5	3
Wyoming	58	59	55
Total U. S.	1,746	1,691	1,809
Cum. avg. to date	1,587	1,577	1,709
Western Canada	79	87	85
Eastern Canada	0	0	2
Grand Total	1,825	1,778	1,896

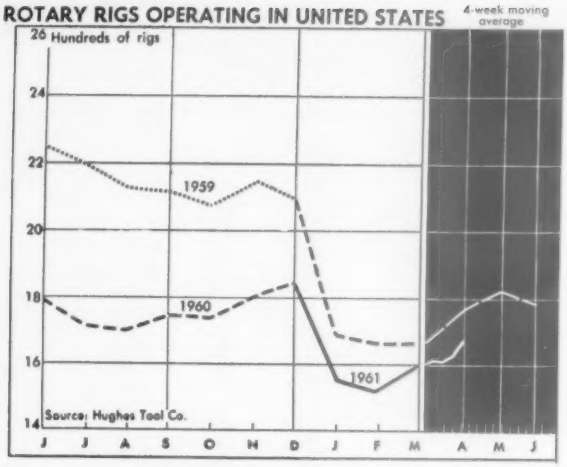
Hughes Tool Co. report.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED APRIL 29, 1961

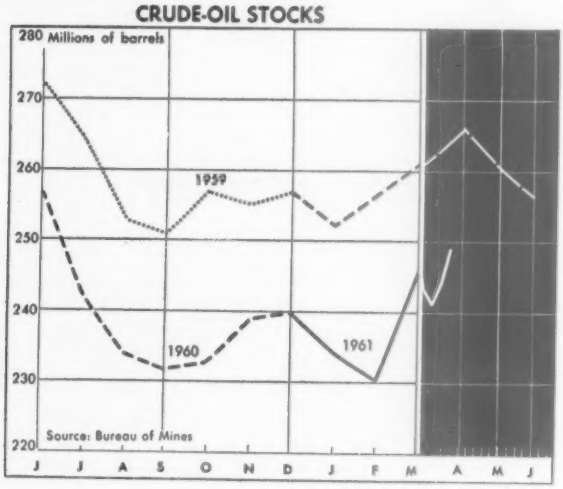
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Alabama	0	0	0	0	0	0	0	20	17	0	0	0	0	0	4	1
Alaska	0	0	0	0	0	0	0	10	.....	0	0	0	0	0	1	.....
Appalachian	14	1	0	12	1	0	28,040	682	543	0	0	0	0	0	19	16
Arizona	3	0	0	0	3	0	4,220	8	6	2	0	0	0	2	6	6
Arkansas	14	6	0	3	5	0	59,515	176	203	0	0	0	0	0	32	51
California	39	26	0	1	12	0	182,353	568	426	7	0	0	0	7	89	94
Colorado	8	1	0	1	6	0	48,231	210	224	3	0	0	0	3	106	105
Illinois	15	3	0	0	11	1	37,620	534	623	4	0	0	0	4	113	159
Indiana	16	3	0	0	12	1	27,645	191	289	6	0	0	0	6	49	118
Kansas	119	51	0	9	44	15	212,766	1,718	1,002	12	1	0	3	8	334	338
Kentucky	10	0	0	0	8	2	10,026	517	553	4	0	0	0	4	60	67
Louisiana	71	37	2	6	26	0	586,462	1,177	1,060	10	0	0	1	9	172	162
North	18	6	0	2	10	0	66,342	378	334	5	0	0	0	5	64	67
South	39	21	2	1	15	0	374,517	605	543	3	0	0	0	3	93	83
Offshore	14	10	0	3	1	0	145,603	194	183	2	0	0	1	1	15	12
Michigan	11	4	0	0	7	0	39,734	217	237	6	0	0	0	6	90	76
Mississippi	13	3	1	0	9	0	138,340	173	262	4	0	0	0	4	57	83
Montana	4	3	0	0	1	0	17,599	124	76	1	0	0	0	1	53	37
Nebraska	17	6	0	0	11	0	87,299	287	254	4	1	0	0	3	117	100
New Mexico	28	12	0	7	9	0	144,510	562	605	7	1	0	0	6	107	85
West	16	6	0	5	5	0	73,824	225	203	3	0	0	0	3	36	19
East	12	6	0	2	4	0	70,686	337	402	4	1	0	0	3	71	66
North Dakota	4	4	0	0	0	0	27,535	76	100	0	0	0	0	0	19	17
Ohio	10	3	0	2	3	2	28,792	337	353	0	0	0	0	0	13	16
Oklahoma	145	69	3	12	36	25	417,013	1,995	1,218	2	0	1	0	1	203	227
Texas	283	137	16	15	96	19	1,257,343	4,621	5,271	50	2	3	1	44	960	1,072
District 1	32	16	0	0	12	4	77,349	296	387	6	0	0	0	6	98	135
District 2	17	3	3	3	8	0	129,565	228	230	8	0	1	1	6	52	55
District 3	25	8	5	2	10	0	188,327	347	406	6	0	1	0	5	70	77
District 4	22	4	3	2	12	1	132,023	381	387	7	0	1	0	6	83	110
East	23	16	5	0	2	0	127,150	370	395	2	0	0	0	2	79	81
District 7-B	47	21	0	4	13	9	122,979	662	773	6	0	0	0	6	187	226
West	57	37	0	1	17	2	295,879	1,152	1,399	11	1	0	0	10	261	223
District 9	45	26	0	0	16	3	114,802	761	962	2	1	0	0	1	94	140
District 10	15	6	0	3	6	0	69,269	424	332	2	0	0	0	2	36	25
Utah	4	1	0	1	2	0	25,065	93	96	2	0	0	0	2	38	35
Wyoming	20	11	0	1	8	0	109,925	331	311	7	1	0	0	6	124	130
Misc. (Wash.)	1	0	0	0	1	0	3,115	85	40	1	0	0	0	1	78	29
Total U. S.	849	381	22	70	311	65	3,493,148	14,712	13,769	132	6	4	5	117	2,844	3,024
Total prev. week	832	360	16	67	349	40	3,372,852	.....	.....	186	12	2	8	164	.....	.....
Cum. 1961	14,712	6,728	311	1,422	5,313	938	59,905,707	.....	.....	2,844	227	35	136	2,446	.....	.....
Cum. 1960	13,769	6,434	449	1,140	5,352	394	60,810,069	.....	.....	3,024	267	32	94	2,631	.....	.....
Western Canada	33	21	0	6	6	0	240,506	764	771	7	2	0	3	2	241	234

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	4-22-61	4-15-61	4-23-60
Pennsylvania	2,095	2,074	2,119
Other Appalachian	1,297	1,239	1,647
Illinois, Indiana, Michigan	8,825	9,039	9,451
Nebraska and North Dakota	3,071	3,073	2,685
Kansas	9,537	9,643	9,785
Oklahoma	17,217	16,120	17,512
Arkansas	1,883	1,971	2,255
Louisiana	20,442	20,215	18,957
North	3,484	3,348	3,172
South	16,958	16,867	15,785
Mississippi, Alabama, Florida	1,845	2,121	2,282
New Mexico	7,428	7,611	7,510
Texas	106,552	104,155	113,685
East Texas	8,894	8,770	8,742
West Texas	49,414	48,085	50,959
Texas Gulf	18,668	17,777	21,053
Other Texas	29,576	29,523	32,931
Wyoming	18,415	17,479	17,708
Other Rocky Mountain	9,707	9,831	9,757
California	25,294	25,426	29,256
Foreign	†15,770	14,707	17,316
Total	**249,378**	244,704	261,925

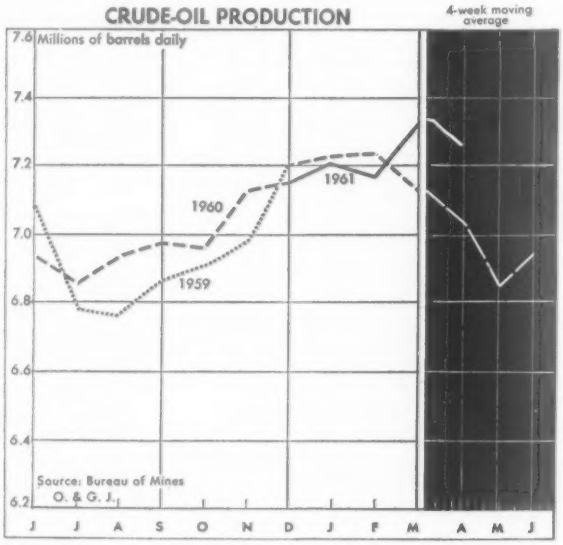
*Bureau of Mines. †Includes 5,197,000 bbl. in California.

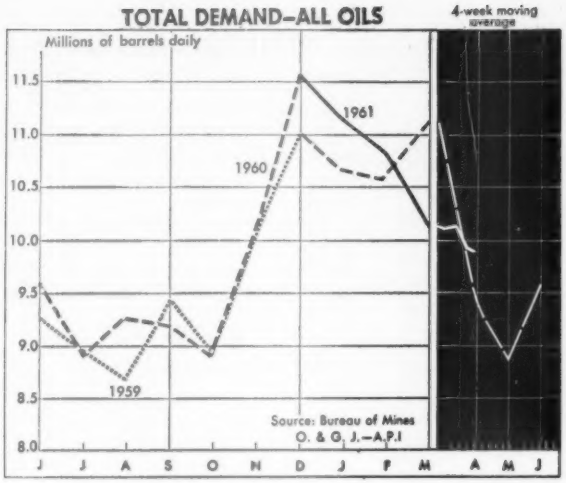
DAILY AVERAGE PRODUCTION FOR WEEK

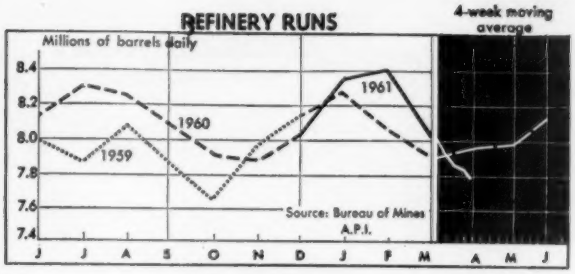
	April 29, 1961			Apr. 22
	Crude oil	Lease condensate	Total	total
Alabama	19,250	.....	19,250	19,300
Alaska	12,000	.....	12,000	11,000
Arkansas	82,565	110	82,675	77,625
California	828,000	.....	828,000	828,700
Colorado	132,500	.....	132,500	132,300
Eastern	39,000	.....	39,000	39,100
Florida	1,100	.....	1,100	1,100
Illinois	208,700	.....	208,700	216,300
Indiana	30,700	.....	30,700	30,400
Kansas	†320,275	.....	†320,275	†316,200
Kentucky	49,300	.....	49,300	49,300
Louisiana	1,003,900	158,500	1,162,400	1,162,900
North	103,900	6,000	109,900	110,400
South	900,000	152,500	1,052,500	1,052,500
Michigan	53,000	.....	53,000	52,900
Mississippi	146,900	4,725	151,625	151,625
Montana	81,300	.....	81,300	81,100
Nebraska	67,300	.....	67,300	69,200
Nevada	450	.....	450	450
New Mexico	304,000	7,400	311,400	311,400
North Dakota	64,000	.....	64,000	66,400
Oklahoma	†545,550	.....	†545,550	†546,200
Texas	2,540,000	94,750	2,634,750	2,634,750
Dist. 1	45,000	2,400	47,400	47,400
Dist. 2	110,000	8,600	118,600	118,600
Dist. 3	312,000	40,000	352,000	352,000
Dist. 4	185,000	14,000	199,000	199,000
Dist. 5	28,000	400	28,400	28,400
Dist. 6	118,000	8,200	126,200	126,200
East Texas field	136,000	.....	136,000	136,000
Dist. 7-B	131,000	400	131,400	131,400
Dist. 7-C	117,000	3,650	120,650	120,650
Dist. 8	1,064,000	11,000	1,075,000	1,075,000
Dist. 9	190,000	3,800	193,800	193,800
Dist. 10	104,000	2,300	106,300	106,300
Utah	80,000	.....	80,000	84,000
Wyoming	387,100	.....	387,100	385,900
Others	‡725	.....	‡725	‡525
Total U. S.	6,997,615	265,485	**7,263,100**	7,268,675
Change from previous week, down			**5,575**	
Canada	†573,900	.....	†573,900	†599,100
Total U. S. prod.—January 1-April 29				862,650,800 bbl.
Same period last year (crude plus cond.)				*859,199,700 bbl.

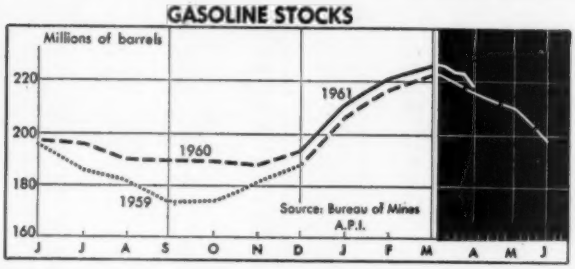
*Includes 27,916,620 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona.

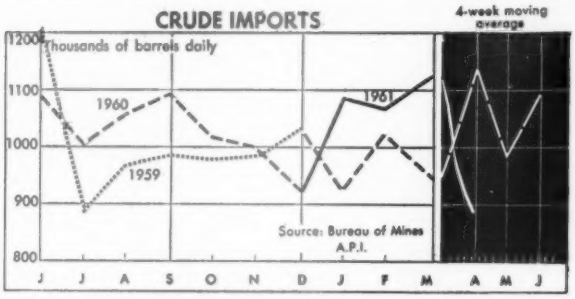
CRUDE-OIL PRODUCTION

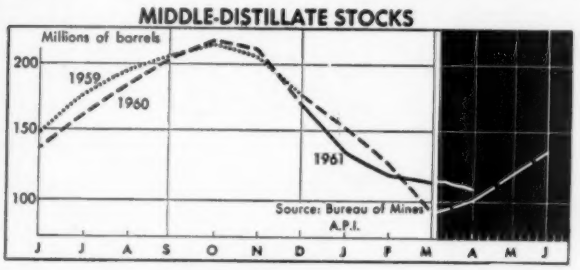


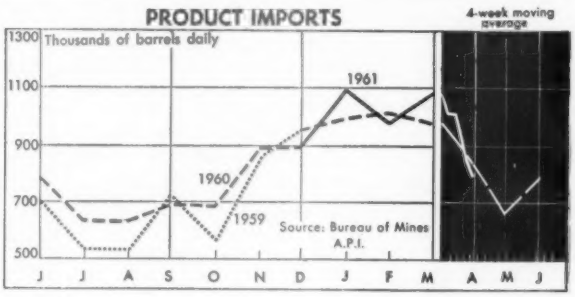


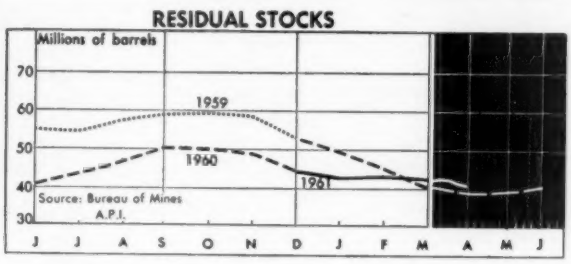












API REFINERY REPORT—APRIL 28, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Buraeu of Mines, April 1960—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,043	451.4	18.7	307.8	150.0	50,364	9,470	24,331	10,860	1,057	510.8	30.1	300.0	146.7
Appalachian:														
Dist. 1	104	42.4	3.1	21.6	10.1	6,179	711	1,811	453	100	41.9	2.9	23.3	12.3
Dist. 2	97	54.3	5.4	18.4	13.1	3,270	364	896	395	90	46.2	4.2	16.2	15.2
Ind., Ill., Ky	1,280	675.9	70.2	207.9	131.9	41,653	4,252	14,429	5,031	1,480	765.8	77.8	301.0	166.3
Minn., Wis., Dak.	99	50.0	3.3	24.9	14.3	6,921	570	3,662	615	116	56.1	6.4	27.7	14.3
Okla., Kans., Mo.	646	360.7	18.6	109.0	10.1	19,945	1,309	8,444	864	694	350.0	17.4	151.5	14.6
Inland Texas	300	208.3	7.0	49.1	20.7	8,382	541	1,494	2,597	283	212.8	8.2	51.4	20.7
Texas Gulf Coast	1,985	943.4	83.2	482.0	125.0	30,286	3,195	8,549	4,676	1,886	964.0	93.9	439.5	141.2
La. Gulf Coast	646	381.4	50.7	116.0	48.9	10,561	2,958	4,483	1,268	665	366.6	46.9	154.7	48.8
N. La. and Ark.	76	56.1	4.1	15.3	5.3	6,316	760	1,900	97	106	65.2	5.5	21.6	4.7
Rocky Mountain:														
New Mexico	22	11.3	0.6	4.4	1.4	802	51	163	88	23	11.4	0.1	4.3	2.5
Other Rocky Mt.	256	115.6	4.4	58.0	28.0	7,656	357	2,306	928	265	114.4	1.5	60.7	24.1
West Coast	1,184	575.3	41.1	196.3	288.3	26,982	1,688	11,540	13,403	1,196	541.3	29.9	191.0	268.9
Apr. 28, 1961	7,738	3,926.1	310.4	1,610.7	847.1	219,317	26,226	84,008	41,275	7,960	4,046.5	324.8	1,743.3	880.3
Apr. 21, 1961	7,765	3,851.9	373.4	1,602.4	854.3	222,225	26,447	84,622	41,791	.....	.....	.....	.....	.....
Apr. 29, 1960	7,945	3,929.6	321.1	1,716.0	946.0	219,524	20,024	81,375	39,320	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Julesburg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	(†)	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague. †Two buyers announced increase.

FLAT PRICES

Louisiana:
- Sweet Lake $3.00

Texas:
- East Texas 3.05-3.25
- Conroe 3.23-3.53
- Van 3.08

Pennsylvania Grade:
- Bradford $4.75-4.80
- Middle District 4.52
- Southwest Pennsylvania 4.25
- West Virginia 4.17
- Buckeye Grade 4.08

Illinois Basin 3.00-3.05

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)
- Arabian, 34.0°-34.9°, Ras Tanura $1.80
- Iranian, 34.0°-34.9°, Bandar Mashur 1.78
- Iranian, 34.0°-34.9°, Abadan 1.73
- Iraq, 35.0°-35.9°, Fao 1.72
- Kuwait, 31.0°-31.9°, Mina-al-Ahmadi 1.59
- Qatar, 41.0°-41.9°, Umm said 1.95

Middle East, E. Mediterranean:
- Arabian, 34.0°-34.9°, Sidon $2.17
- Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli 2.19

Far East (cargoes, f.o.b. Lutong, Sarawak):
- Seria Light, 36° 2.42

Canada:
- Leduc-Woodbend $2.53
- Redwater (Alta.) 2.42
- Weyburn (light) 2.06
- Midale C 1.70

Venezuela:
- Cumbarebo, 47°-47.9°, Tucupido 3.34
- San Joaquin, 40°-40.9°, Puerto La Cruz 3.08
- Oficina, 35°-35.9°, Puerto La Cruz 2.80
- Tia Juana medium, 26°-26.9°, Amuay* 2.30
- Quirdiquire, 16.0°-16.4°, Caripito 2.10
- Lagunillas heavy, flat, Las Piedras* 2.10
- Bachaquero, flat, 15°-16°, Las Piedras* 1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long Ton)

(Latest reported spot fixtures)

- ★ Gulf-NY, clean (ATRS—22.5%) $2.21
- ★ Gulf-NY, dirty (ATRS—17.5%) 2.35
- ★ Carib.-NY, dirty (ATRS—65%) 0.96
- ★ PG-Japan, dirty (USMC—80%) 2.04
- ★ PG-UK, dirty (Scale—72.5%) (19s. 5d.) 2.72

★Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):
- ★ Regular (91 octane) .. 11.50-12.00
- ★ Premium (99 octane) 14.25-14.50
- Natural gasoline (26-70) 4.5
- Breckenridge 4.0

Gulf Coast (cargoes for coastwise or export movements):
- Regular (90 octane) .. 10.50-11.00
- Regular (92 octane) .. 10.75-11.25
- Premium (98 octane). 11.75-12.25

California (rack) Los Angeles:
- Regular (90 octane) 11.00
- Premium (94 octane) 12.00
- Premium (100 octane) 13.50

Caribbean area (cargoes):
- Regular (87 octane) 9.50
- Premium (97 octane) 11.625

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):
- ★ Kerosine 42-44 .... 10.125-10.375
- ★ Diesel oil (58 d.i. and above) 9.75-10.00
- ★ Distillate No. 1 .... 9.50-10.00
- ★ Distillate No. 2 ..... 8.50-9.00

Gulf Coast (cargoes):
- Kerosine 41-43 ..... 9.625-9.875
- Distillate No. 2 ..... 8.5-9.25

New York Harbor (barges):
- Kerosine 42-43 ..... *11.40
- Distillate No. 2 ..... *10.40
- Diesel fuel, 48-52 d.i. *10.55

Caribbean area (cargoes):
- Distillate No. 2 ..... 8.625

*Subject to 0.5 cent discount.

RESIDUAL FUEL (Bbl.)

Mid-Continent (Group 3):
- Residual fuel (max. 1% S) .. $1.90

Gulf Coast (cargoes):
- Bunker C fuel 2.20

New York Harbor (barges):
- Bunker C fuel 2.52

Caribbean (cargoes):
- Bunker C fuel 2.00

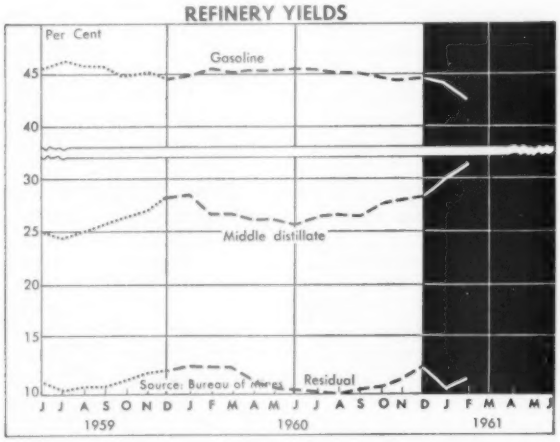
California (rack):
- Bunker C fuel, Los Angeles 2.25

SUPPLY AND DEMAND—PRODUCTS
(Thousands of barrels daily)

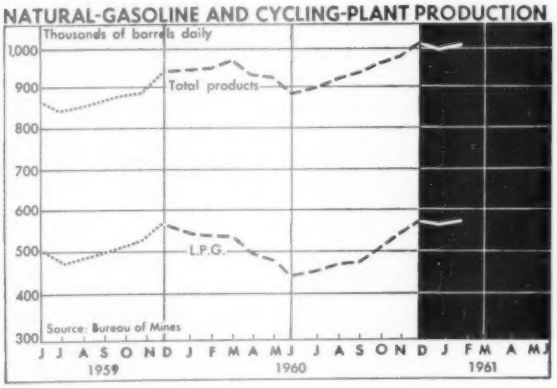
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
April 1961*	4,320	3,940	219,300
March 1961*	3,990	4,060	226,400
February 1961	3,790	4,079	222,189
May 1960	4,238	3,989	210,509
April 1960	4,357	4,047	216,100
KEROSINE			
April 1961*	360	355	26,200
March 1961*	370	425	26,000
February 1961	540	430	24,471
May 1960	202	318	24,217
April 1960	257	325	20,547
DISTILLATE			
April 1961*	1,840	1,615	84,000
March 1961*	2,075	1,795	89,700
February 1961	2,687	2,259	97,298
May 1960	1,343	1,737	95,461
April 1960	1,539	1,743	81,755
RESIDUAL			
April 1961*	1,570	840	41,300
March 1961*	1,895	910	42,300
February 1961	1,930	991	42,635
May 1960	1,346	841	39,628
April 1960	1,584	880	39,285

*Preliminary. †Thousands of barrels.

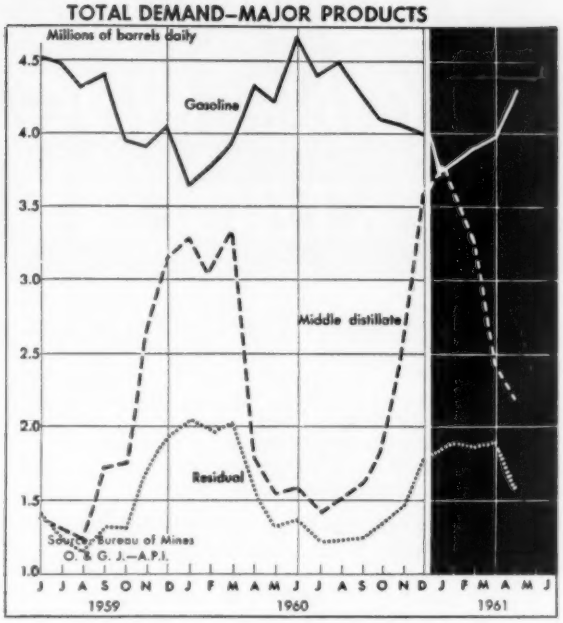
REFINERY YIELDS



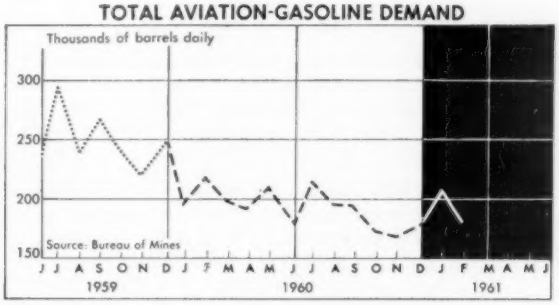
NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



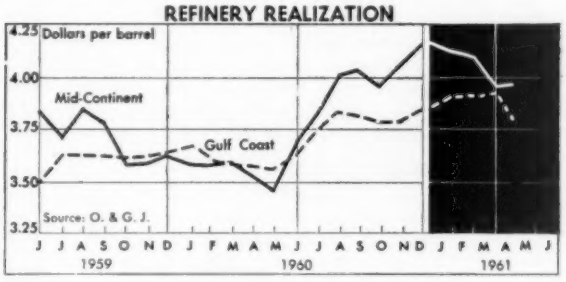
TOTAL DEMAND–MAJOR PRODUCTS



TOTAL AVIATION-GASOLINE DEMAND



REFINERY REALIZATION



REFINERY REALIZATION

	Apr.*	Mar.*	Feb.	Jan.
Mid-Continent	$3.97	$3.96	$4.04	$4.02
Gulf Coast	3.78	3.93	3.96	3.96

*Preliminary. Refinary realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel and residual as published in The Oil and Gas Journal.

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NATURAL GAS Engineer with engineering degree plus 3 to 5 years experince in plant design or operation for work in the Gulf Coast Area. Amerada Petroleum Corp., Gas Department, P. O. Box 2040, Tulsa, Oklahoma.

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GEOLOGIST with five to eight years experience, mostly in Southern Louisiana, to open Lafayette District Exploration Office. Address statement of education and experience to: H. W. Bass & Sons, Inc., 1150 Mercantile Dallas Building, Dallas 1, Texas.

GRADUATE ENGINEER with 5—10 years field construction experience of gas transmission lines and who is also familar with office work. Prefer applicant not over 40. Salary open. Send resume to Box M-364, The Oil and Gas Journal, Tulsa, Oklahoma.

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PRODUCTION WANTED

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SEALED BIDS will be received until 10:00 A.M. Mountain Standard Time, June 2, 1961, and opened at that time in the office of the Navajo Indian Agency, Window Rock, Arizona, for oil and gas leases on 14 tracts of Tribal lands, totaling approximately 2,456.54 acres, located in San Juan County, Utah. Details of the lease offering and filing of bids may be obtained by addressing an inquiry to General Superintendent, Navajo Indian Agency, Attention: Branch of Realty, Window Rock, Arizona.

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SALE OF OIL AND GAS MINING LEASES. Department of the Interior, Bureau of Indian Affairs, Jicarilla Indian Agency, Dulce, New Mexico. Sealed bids will be received until 3:00 P.M., Mountain Standard Time, May 24, 1961, and then opened at that time in the office of the Jicarilla Indian Agency, Dulce, New Mexico, for the leasing of 11,150 acres of Tribal Indian Land located in Rio Arriba County, New Mexico, within the Jicarilla Indian Reservation for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Jicarilla Indian Agency, Dulce, New Mexico.

LEGAL

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF INDIAN AFFAIRS, Crow Indian Agency, Crow Agency, Montana. Sealed bids will be received until May 24, 1961, 2:00 o'clock, P.M., Mountain Standard Time, and opened at that time in the office of the Crow Indian Agency, Crow Agency, Montana, for the leasing of 14,853.45 acres of tribal land and 840 acres of allotted lands all located in Twps. 6, 9 and 10 South, Rges 32, 37 and 38 East, Big Horn County, Montana, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of Crow Indian Agency, at Crow Agency, Montana.

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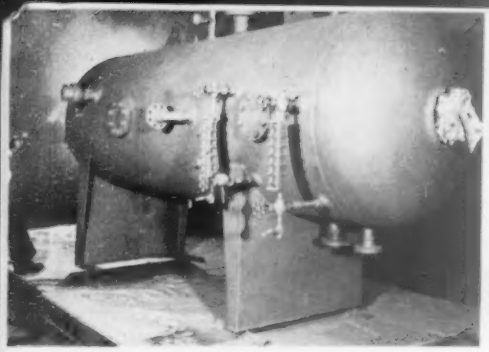
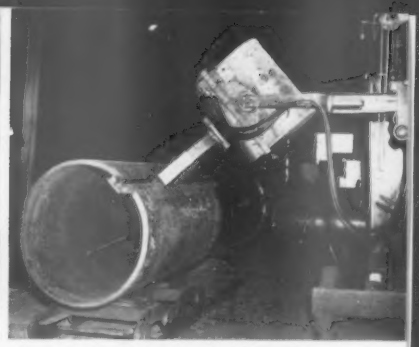


In-Door Sand Blasting rooms afford all weather operation

15' x 15' x 100' long Stress Relieving Furnace



Complete facilities for X-Ray and Gamma Ray

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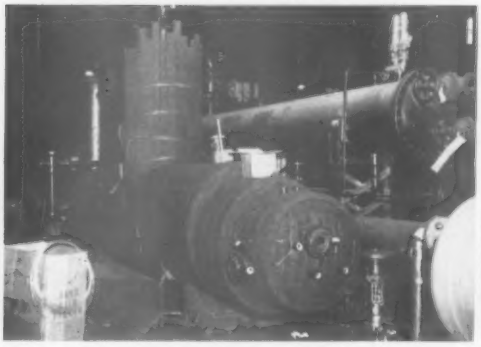
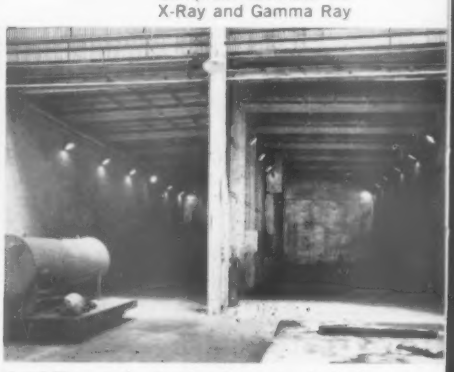
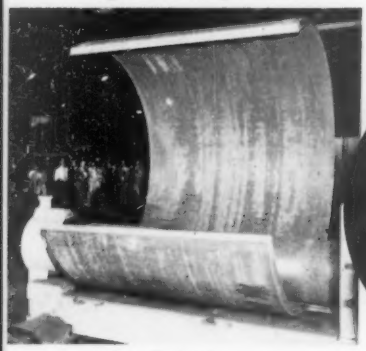


All types of Shop Applied Insulation—pipe, vessels, etc.



Humidity and temperature controlled Sandblasting, Painting and Drying facilities



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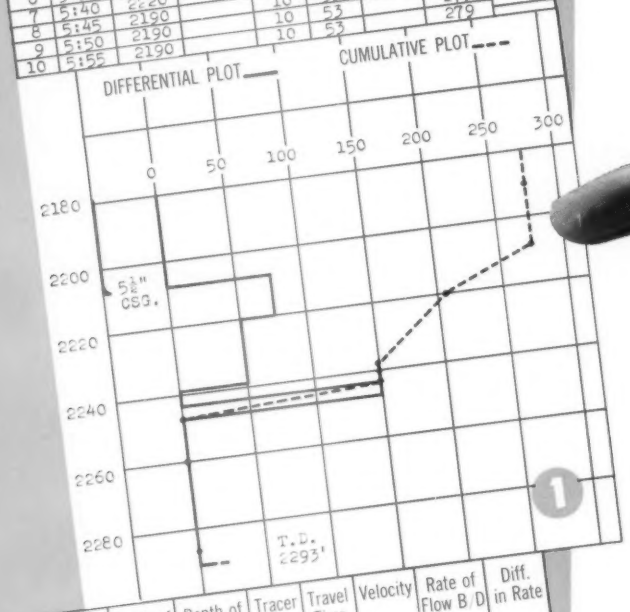
DRAWER 1710

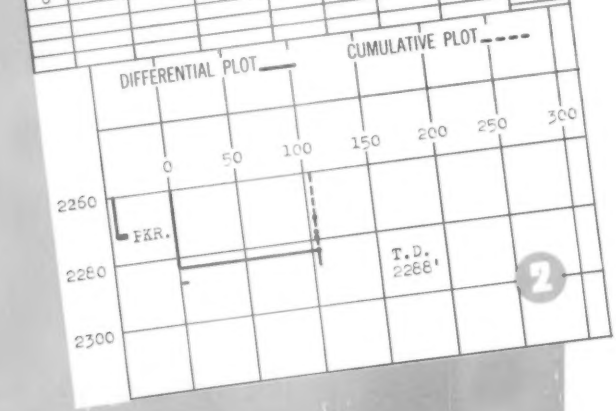
TULSA, OKLAHOMA

Another FIRST by LANE-WELLS

Shot No.	Time of Day	Depth of Detector	Depth of Mid Point	Tracer Travel Feet	Travel Time Sec's	Velocity Ft/Sec	Rate of Flow B/D Q K/t	Diff. in Rate
				10	334		0	
				10	325		0	
1	5:00	2287		10	300		152	152
2	5:07	2260		10	97		152	0
3	5:15	2248		10	97		152	0
4	5:20	2244		10	97		203	51
5	5:25	2240		10	73		279	76
6	5:30	2239		10	53		279	
7	5:40	2220		10	53		279	
8	5:45	2190		10	53		279	
9	5:50	2190						
10	5:55	2190						



Shot No.	Time of Day	Depth of Detector	Depth of Mid Point	Tracer Travel Feet	Travel Time Sec's	Velocity Ft/Sec	Rate of Flow B/D Q K/t	Diff. in Rate
				5	12		110	0
					12		110	0
1	11:30	2283			12		110	0
2		2279			12		110	0
3		2279			15		110	
4		2278			15			
5		2274						
6		2274						



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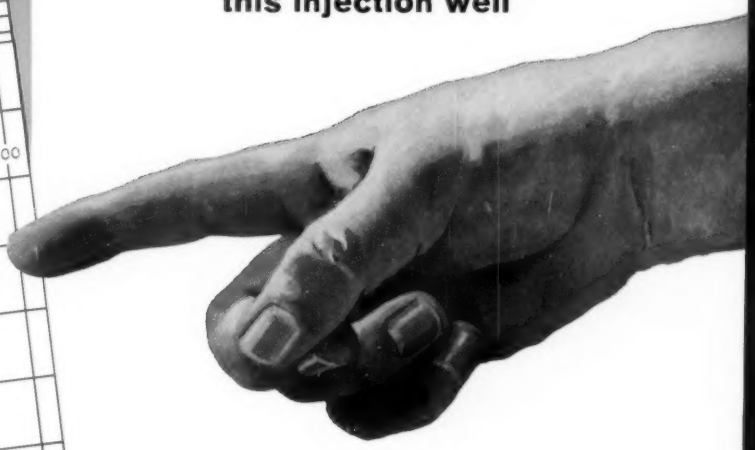
How LANE-WELLS *NEW*

Nuclear Flolog

put the finger on costly water loss in this injection well



1. In this West Texas waterflood operation extensive injection had not resulted in desired production. A Lane-Wells Nuclear Flolog was run in this well, and showed all injection water entering upper section of the zone between casing shoe and 2248 feet. On the basis of this information, a packer was set at 2273 feet to direct fluid into zone below.
2. Subsequent Nuclear Flolog showed all water entering the desired area, the lower five feet of the zone.

What the Nuclear Flolog Does

The Nuclear Flolog is a unique type of nuclear tracer survey which provides a profile of points of entry into or out of the formation.

By injecting 2 cc. of tracer laden material at each of a number of points in the borehole and recording the time required for this material to reach the detector a log of flow rates in the zones of interest is plotted and translated into barrels per day. **As many as 100 stations may be recorded on one run in the hole.**

This information is a valuable aid in determining the receptivity of injection zones and the possible need for corrective measures.

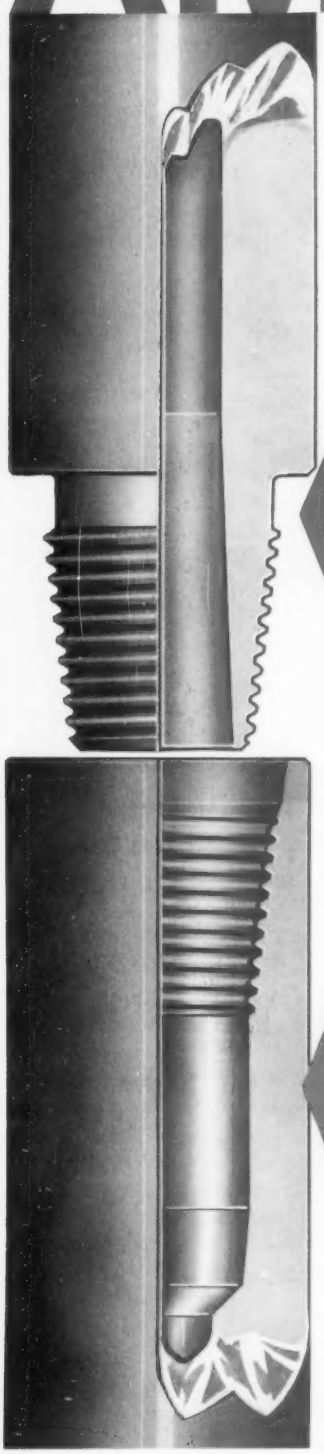
In producing zones, the exact area of production is established. The need for, and precise point of, corrective treatment can be determined.

In any operation where a log of downhole fluid movement is of value, the Nuclear Flolog is the answer. Ask your Lane-Wells representative, or write P. O. Box 1407, Houston, Texas, for further information.

More hole at LESS expense when YOU use

AMERICAN IRON

DRILL COLLARS



with API RECOMMENDED STRESS RELIEF CONTOURS

Laboratory fatigue tests and test under actual conditions have demonstrated the beneficial effects of stress-relief contours at the pin shoulder and at the base of the box thread. Other API recommendations for drill collars, to which AMERICAN IRON conforms, relate to diameter, bore size for given diameters and a selection of an API thread form.

Write AMERICAN IRON for these API recommendations or they may be seen on pages 14 and 15 of the API Standard 7, 16th Edition, April, 1960.

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